SB 8-75-S5

DEPARTMENT OF THE ARMY SUPPLY BULLETIN

Army Medical Department Supply Information

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

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NOTICE

This Supply Bulletin is devoted entirely to the Medical Materiel Acquisition Information

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CHAPTER 1. GENERAL INFORMATION

1-1. INTRODUCTION - GENERAL INFORMATION

a. The U.S. Army Medical Command (USAMEDCOM) has tasked the U.S. Army Medical Materiel Agency (USAMMA), Materiel Acquisition Directorate, Technology Support Division (MMT-S), Fort Detrick, MD, with the following areas of responsibility:

(1) The Technology Assessment and Requirements Analysis (TARA) for Tables of Distribution and Allowances (TDA) facilities.

(2) The Combat Support Equipment Assessment (CSEA) for Tables of Organization and Equipment (TOE) facilities.

TARA and CSEA are management tools that provide an unbiased review of the clinical requirements and operations for medical treatment facilities (MTFs). The goal of the TARA and CSEA is to provide decision makers at the USAMEDCOM with the management information needed to make informed decisions on the clinical and technological resources required to accomplish business plan missions and to develop acquisition strategies that ensure optimal clinical outcomes. The USAMMA is also responsible for acquisition and logistics management of new and replacement medical equipment and supplies for the TOE medical units and TDA medical facilities. In support of this mission, the MMT-S supports the Army Medical Department (AMEDD) in market and technology surveillance, equipment analysis, acquisition support, and program management.

b. The TARA team is invited to the MTF and provides the Commander with a "snapshot" of the facility's diagnostic imaging and laboratory capability during an outbrief at the conclusion of the site visit. This is followed by a timely, written report. The information obtained from the TARA visit can assist the Commander in managing his equipment and personnel, as well as improve and streamline his operation. In addition, requirements for new equipment can be centrally generated based on the TARA report.

c. In an environment of reduced fiscal resources, it is imperative that we apply sound business practices to our capital investment equipment programs. The decision makers at the USAMEDCOM, Regional Medical Commands (RMCs), and individual TDA or TOE facilities must have a viable means of acquiring the management information they need to effectively balance their limited resources with clinical requirements.

d. The TARA program presently focuses on diagnostic imaging and radiotherapy equipment. As the radiology model for the TARA program evolved, the USAMMA was tasked to expand the TARA to include other clinical areas and programs. The USAMMA has developed a laboratory module to assist management at Army Medical Centers (MEDCENs) with consolidating testing equipment and promoting efficient work areas. In addition, the TOE model has been developed to assist decision-makers with providing the appropriate equipment and technology to our field hospitals.

1-2. OVERVIEW OF SB 8-75-S5

a. Chapter 2 discusses the MEDCASE program. MEDCASE program is a centralized funding program that provides the capital investment equipment required to support Army health care activities at fixed Army MTFs throughout the world. Equipment requirements originate at the activity level and are reviewed and approved at levels that depend on dollar value. The TARA database is used to front-load MEDCASE requirements for routine replacement of diagnostic imaging systems and acquisition of newly recommended equipment.

b. Chapter 3 discusses site preparation. Site preparation is the responsibility of the individual activity. The TARA Team can act as consultants for site preparation information.

c. Chapter 4 discusses the goals of military radiology. The goal of military radiology is to be the prime provider of high-quality radiology services to all DOD beneficiaries of health care. The Military Radiology Functional Economic Analysis (FEA) discusses the vision of the military radiology community.

d. Chapter 5 provides details on the TARA program, its history, and future directions. The TARA team needs to understand the vision of the Commander to effectively evaluate each facility. Information on the facility is requested in advance or during the TARA site visit. Without the vision of the facility Commander and accurate data on workload, patient trends, and equipment, the TARA team can only provide its best estimates on future needs of each facility.

e. Chapter 6 discusses the CSEA. Conducting the CSEA involves identifying non-sustainable/non-supportable equipment that is currently in use and conducting market investigations and market surveillance to identify suitable replacements. The CSEA will help ensure deployable MTFs, such as the Deployable Medical Systems (DEPMEDS), are kept at an appropriate level of readiness.

f. Chapter 7 discusses managing technology in the military laboratory. Management of laboratories in departments of pathology requires a review of the cost efficiency of procuring new equipment versus equipment or reagent rental and cost-per-test contracting. As equipment reaches its life expectancy and before purchasing new equipment, the possible benefits of cost-per-test contracting and reagent rental contracts should be evaluated.

g. Chapter 8 provides information on the Digital Imaging and Communication in Medicine (DICOM) standard. The DICOM standard will allow radiology devices to interface with each other, even if they are miles apart and manufactured by different vendors. All new purchases or upgrades for Army MTFs should support the current DICOM standard.

h. Chapter 9 discusses a sample data collection program being implemented to allow a rapid response to changes or trends in medical technology for deployable MTFs. The goal is to ensure MTFs have the most current and cost-effective technology available.

i. Chapter 10 discusses telecommunications issues and equipment. In some cases, telecommunications infrastructure at many Army MTFs is inadequate to support new telemedicine or teleradiology initiatives.

j. Chapter 11 discusses voice-recognition software. Although still developing, speech recognition software can improve the cost efficiency and productivity of the radiology department.

k. A Glossary of Abbreviations follows Chapter 11.

1-3. PURPOSE AND APPLICABILITY OF SB 8-75-S5

a. This SB 8-75-S5 issue outlines the policies and procedures in the TARA program that are used by the USAMMA MMT-S in the TARA program. In addition, information concerning technologies that support digital environments required for teleradiology/telepathology programs is provided.

b. Programs identified in this publication, e.g., Medical Diagnostic Imaging Support (MDIS) System or DIN-PACS, are not solely the responsibility of the USAMMA MMT-S; however, as technology program administrators, facilities are encouraged to contact the MMT-S for guidance on these issues. Point of contact (POC) is the USAMMA, ATTN: MCMR-MMT-S, Fort Detrick, MD 21702-5001; DSN 343-4473/301-619-4473.

1-4. RESPONSIBILITIES OF THE USAMEDCOM

a. The USAMEDCOM is the Medical Care Support Equipment (MEDCASE) program manager. Asset management (based on information obtained by the TARA program) is necessary to ensure accessible, high-quality care, despite reductions in U.S. Army size and budget.

b. Functional consultants are provided by the Office of the Surgeon General (OTSG) and deployed with the TARA team to gather information with a focus on clinical operations.

c. The Diagnostic Imaging and Radiotherapy Subcommittee (DIRS) is a subcommittee of the Strategic Technology and Clinical Policies Council (STCPC). This subcommittee provides recommendations to the STCPC on leading edge or controversial MEDCASE program requirements for diagnostic imaging or radiation therapy equipment.

d. The USAMMA administers the TARA and CSEA for the USAMEDCOM. The USAMMA MMT-S performs the TARA and CSEA. The MMT-S is appointed by USAMEDCOM and serves as the functional consultant for reviewing and providing propriety approval or disapproval for MEDCASE Program Requirements (MPRs) with a unit price of $350,000 or greater ($100,000 or greater for diagnostic imaging equipment).

e. The RMCs and MSCs manage the development and execution of MEDCASE requirements within their command.

f. MEDCASE Program Participants. MEDCASE program participants invite the TARA to assist them in developing equipment requirements consistent with mission needs. The activity Commander shall review and approve or disapprove requirements. Once the hospital Commander approves the requirement, the RMC reviews for final approval.

g. The USAMMA MMT-S works with other agencies that have related responsibilities ensuring that all groups are kept informed and part of the decision-making process. The MMT-S works with the U.S. Army Health Facilities Planning Agency (HFPA) to ensure that the TARA recommendations (including communications infrastructure and new equipment) match the facility plans. The Division also works with the Army Medical Department Center and School (AMEDDC&S) to determine workload requirements and to ensure appropriate technology is available for the Area Medical Laboratory (AML). In addition, the USAMMA MMT-S is working with the AMEDDC&S to identify the equipment differences between the AML and the theater area medical laboratory (TAML).

h. The MMT-S continues to support development of requirements and fielding of the Army portion of the tri-service Digital Imaging Network—Picture Archiving and Communication System (DIN-PACS) program and other PACS issues. However, the Army PACS Program Management Office (APPMO) at the U.S. Army Medical Research and Materiel Command (USAMRMC) now does central management of PACS for the Army. The APPMO can be contacted at:

APPMO
MCMR-ZF-PAC
504 Scott Street
Fort Detrick, MD 21702
Telephone DSN 343-3045/301-619-3045

CHAPTER 2. MEDICAL CARE AND SUPPORT EQUIPMENT (MEDCASE) PROGRAM

2-1. INTRODUCTION - MEDCASE PROGRAM

The MEDCASE Program centrally funds the capital investment equipment required to support Army health care activities at fixed Army MTFs throughout the world. Equipment requirements originate at the activity level and are reviewed and approved depending on dollar value, at the activity, the RMC, the USAMMA, and AMEDD consultants to the Surgeon General. Approved and disapproved requirements are recorded in the AMEDD central database (the MEDCASE Requirements and Execution [MRE] system) maintained by the USAMMA. The USAMMA receives MEDCASE funds from the USAMEDCOM that are managed and controlled in the MRE system for participating RMCs and MSCs. Activity Commanders prioritize approved requirements below $350,000 and execute them either through local purchase procedures or by requisitioning to a wholesale supply source. To review the entire MEDCASE program, refer to the SB-8-75-MEDCASE, dated 10 March 2001.

2-2. THE MEDCASE PROCESS

a. All MEDCASE diagnostic imaging and radiotherapy equipment requirements $100,000 and greater, regardless of Budget Line Item Code (BLIC), are centrally managed by the USAMEDCOM. The Materiel Acquisition Directorate (MMT), USAMMA, is responsible for the coordination of this program. This ensures consistency of application and compliance with AMEDD strategic plans.

b. At the direction of the USAMEDCOM, the MMT has developed and implemented a process to centrally generate MEDCASE requirements identified during a TARA visit. Using the data collected from site visits and MEDCASE program requirements (see Figures 2-1 through 2-3 for MEDCASE process), the TARA Team has constructed a database to assist in providing guidance for approving future MEDCASE requests. Information from the TARA database is used to front-load MEDCASE requirements in the MRE for routine replacement of diagnostic imaging systems. This reduces clinician and logistician administrative workload and eliminates duplication of effort. USAMMA generates the requirements documentation for the MTF, based on TARA recommendations. As a result, the MTF does not have to generate a DA Form 5027-R (MEDCASE Program Requirement [MPR]) or have to generate a DA Form 5028-R (MEDCASE Support and Transmittal Form).

(1) These requirements will have a USAMMA assigned Asset Control Number (ACN) with a 900 series sequence number. The MRE system is preloaded with these requirements and initially has an action code of 5M with Local Use Code (LUC) of TAR (TAR is a code that refers to any requirement generated by the TARA team).

(2) The USAMMA MMT prepares the MEDCASE transmittal outlining those requirements identified during the last TARA visit and coordinates the transmittal through the MTF and the RMC for staffing and concurrence purposes. The RMCs and MTFs should follow their own internal review procedures (Chiefs of Medical Maintenance, Facilities, Logistics, and Radiology; the Deputy Chief for Administration [DCA]; and Commander) in determining whether or not to concur with the requirement. After the MTF and the RMC make the decision to concur or non-concur, the RMC MEDCASE manager must return the documentation showing concurrence or non-concurrence to the USAMMA. The activity MEDCASE manager establishes the requirement in the "Requirements Module" of Army Medical Department Property Accounting System (AMEDDPAS) when the TARA transmittal is received. On receipt of concurrence from both the RMC and the MTF, the USAMMA MMT converts the requirement to approved 1A status in the MRE system.

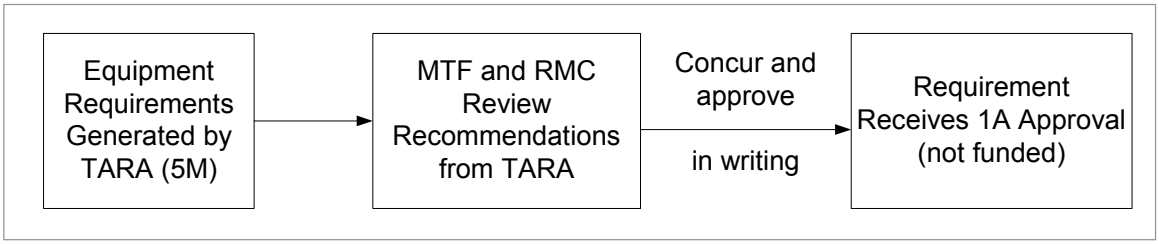

Figure 2-1. Centrally generated MEDCASE Program requirements and process (continued on in Figure 2-3).

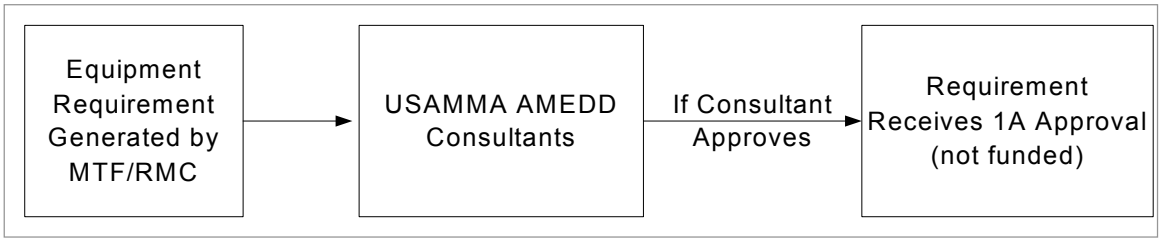

Figure 2-2. MTF generated MEDCASE Program requirements and process (continued in Figure 2-3).

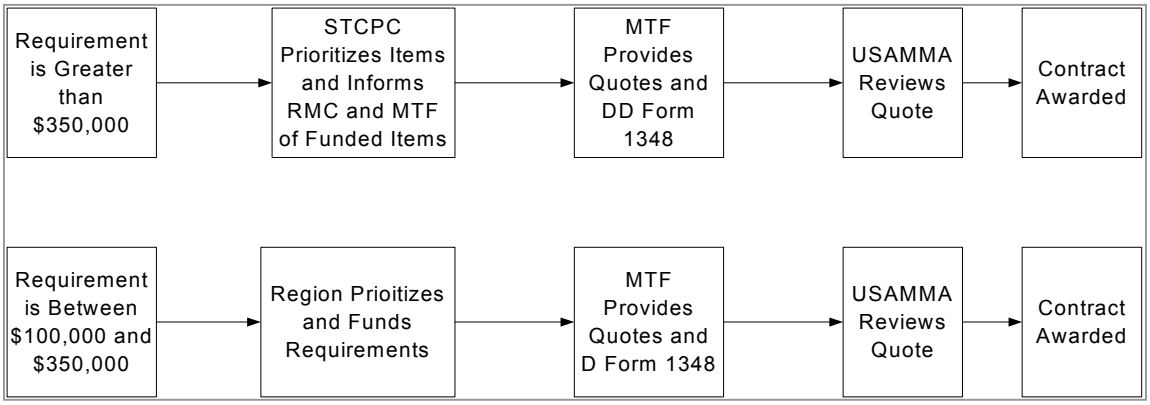

Figure 2-3. Flowchart of the funding process of diagnostic imaging equipment for 1A-approved requirements.

(3) The 1A requirement in the MRE database validates the requirement but does not signify that the requirement is funded. These requirements are used to support the AMEDD's equipment funding budget in the coming fiscal years (FYs). Neither centrally generated requirements nor MTF-generated requirements receive priority for funding; both are reviewed equally by USAMEDCOM.

(4) BLIC UR funding is allocated from USAMEDCOM at two levels:

(a) high-dollar value (those MEDCASE requirements greater than $350,000)
(b) medical-dollar value (those between $100,000 and $349,999).

The USAMEDCOM is responsible for funding all high-dollar value items and funding information is provided to the RMC for medical-dollar value items.

(5) After allocation of medical-dollar value funds, the RMC must have the Program and Budget Advisory Committee (PBAC) determine which of these MEDCASE items to fund. Once the diagnostic imaging equipment is funded, the MTF must submit to the USAMMA MMT-C for final approval DD Form 1348-6 (*DOD Single Line Item Requisition System Document*) and a vendor quote for the system the radiology and logistics departments choose to purchase. Once USAMMA concurs with the quoted system, they forward the requisition package to the Department of Veterans Affairs-National Acquisition Center or the Defense Support Center Philadelphia (DSCP) for purchase.

2-3. MTF-GENERATED MEDCASE PROGRAM REQUIREMENT

a. MTFs may continue to submit requirements, whether or not recognized through the TARA process, at their discretion. In addition, MPRs submitted for changing mission requirements or expanded business opportunities still require the facility to submit a MEDCASE requirement. The process for MTF-generated MPRs has not changed; see the SB 8-75-MEDCASE.

b. The justification must include at a minimum the following information:

(1) What is the item requested to be used for?
(2) Why is the item needed?
(3) How will the item be used with other equipment?
(4) What are the advantages of the requested item compared with equipment currently in use or available?
(5) Why are these advantages needed?
(6) Have specific details been presented regarding cost-benefits, personnel savings or productivity, the enhancement or curtailment of services, frequency or duration of breakdown, or other specific factors that may be relevant?
(7) What will be the impact upon mission accomplishment if the requested item is not acquired?
(8) Is the anticipated workload provided?
(9) Has consideration been given to the use of available excess assets to satisfy this requirement?

2-4. USAMMA MEDCASE MANAGER POINT OF CONTACT (POC)

a. POC is as follows:

USAMMA
ATTN: MCMR-MMT-C
1423 Sultan Dr., Suite 100
Fort Detrick MD 21702-5001

Telephone for both continental United States (CONUS) and outside the continental United States (OCONUS) activities is DSN 343-4328/301-619-4328. Telefax number is DSN 343-4480/301-619-4480.

b. A checklist for the MTF MEDCASE manager is shown in Figure 2-4.

Task	Task Completed
1. Wait for Central MEDCASE Requirements transmittal from the USAMMA for TARA identified requirements	
2. Route through MTF for signatures	
a. Chief, Department of Radiology	
b. Chief, Medical Maintenance	
c. Chief, Facilities	
d. Chief, Logistics	
e. Others required by MTF	
f. DCA (if required)	
g. Commander	
3. Send to RMC for concurrence	
4. RMC should concur/non-concur and forward copy to USAMMA and MTF	
5. Await funding	
6. Once funded, send quote and DD Form 1348-6 to the USAMMA for diagnostic imaging equipment	
7. Await system	

Figure 2-4. Checklist for MEDCASE Manager

CHAPTER 3. SITE PREPARATION REQUIREMENTS

3-1. INTRODUCTION - SITE PREPARATION REQUIREMENTS

a. Each MTF is responsible for site preparation. If not planned and budgeted for, site preparation can become a major problem. Site preparation is normally accomplished by the activity's facility engineer.

b. Site preparation includes certain utility and/or facility modifications that must be made to allow the contractor to install the system. Site preparation is only that work which is specifically required to make the piece of equipment operate and may consist of secondary utility work, special air conditioning requirements, minor rough-in carpentry work, plumbing, the mounting of conduit or the running of wires through conduit, and the mounting of junction boxes, line switches, or fuses or all of these. Facility modification for aesthetic and/or functional changes will not be included in the equipment site preparation request. These modifications will be funded using hospital "core" funds or Defense Health Program (DHP) Major Repair funds.

c. Site preparation is NOT funded by MEDCASE funds. DHP procurement funds cannot be used to finance a service contract. Each MTF must program for and obtain DHP O&M funds for site preparation in accordance with command procedures. In some instances, site preparation can be funded with MILCON funds for BLIC "MB" requirements.

d. Site preparation may be included as part of the installation of equipment by the vendor. However, unless specified in the delivery order, carpentry, plumbing, mounting of conduit or running or wires through conduit, and the mounting of junction boxes, line switches, or fuses are not included in the installation costs.

e. Turnkey acquisition is a strategy where a single vendor performs site preparation as well as supplying and installing new equipment. Because turnkey acquisition is not a local contracting activity, MTFs that consider turnkey acquisition must request an exception to policy to locally procure equipment with turnkey installation.

f. To provide guidance for accomplishing equipment site preparation projects and to delete the requirement for the quarterly Site Preparation/Installation Status Report, site preparation managers should see the Facility Information Bulletin (FIB) 97-039. USAMEDCOM Form 255-R *(Operation and Maintenance, Army [OMA]-Funded Equipment Site Preparation Project Request)* will be used to request site preparation funding. Site preparation managers should also reference USAMEDCOM Regulation 700-2. Detailed information on MEDCASE funding of site preparation is in Department of the Army (DA) Supply Bulletin *SB-8-75-MEDCASE* dated 10 March 2001. Detailed information is available from the Program Manager, USAMEDCOM, Attn: MCFA-M, 2050 Worth Rd, Fort Sam Houston, TX 78234-6000; telephone DSN 471-7154/210-221-7154.

3-2. FUNDS AND FUNDING POLICY FOR SITE PREPARATION

a. Facility Information Bulletins (FIB) are prepared by the Assistant Chief of Staff for Installations, Environment, and Facility Management (ACSIE&FM), USAMEDCOM and distributed as needed to the USAMEDCOM headquarters staff, the HFPA, USAMEDCOM MSCs, and USAMEDCOM facilities worldwide. These bulletins provide facility-related management policy, information or guidance of current interest to the USAMEDCOM ACSIE&FM, Chiefs of Logistics, and facility managers. Local reproduction and distribution is authorized and encouraged. FIB 97-039 provides guidance for accomplishing equipment site preparation projects.

b. This guidance is applicable to all USAMEDCOM MTFs and installations for new equipment ($100,000 and greater in price) purchased through the MEDCASE Program, excess equipment approved for relocation to satisfy MEDCASE requirements, and other equipment on a case-by-case basis. Site preparation will be financed for any equipment purchased (costing $100,000 or greater) through command-managed programs (such as MEDCASE). Once the design and project execution have been funded by ACSIE&FM in accordance with USAMEDCOM Form 255-R submitted by the medical activity, request for additional funds will be made in writing. Prior to incurring any additional obligations for which ACSIE&FM reimbursement is expected, the ACSIE&FM Program Manager must be consulted by telephone to ascertain the availability of funds and the appropriateness of the expense.

c. Any site preparation project less than $1,000 will be funded from local resources. All projects more than $1,000 will be submitted for site-preparation funds.

d. Activities are not authorized to reprogram funds provided for a specific project to any other requirement unless the ACSIE&FM Program Manager approves such reprogramming in writing.

e. Activities are required to intensively monitor site-preparation projects and report excess funds to the ACSIE&FM Program Manager.

f. Projects that include maintenance and repair items ("K" Account) and minor construction ("L" Account) will contain a statement by the MTF activity (facility manager) that funds (DHP hospital "core" or DHP Major Repair) will be provided to cover these requirements.

g. Design can be initially funded by the MTF from their regular resource distribution, if available. The cost of design should not exceed 6 percent of the estimated project cost. On approval of final design, the cost for design will be reimbursed along with project funding.

3-3. INSTALLATION DURING SITE PREPARATION

a. Installation normally consists of physically attaching the equipment to the real property facility (building) and providing devices, plumbing, cabling, or wiring necessary to attach the equipment to the existing utility systems or those utility outlets previously made available through site preparation. Costs for the transportation, assembly, installation, calibration, and testing of equipment are not included in the request for site-preparation funding.

b. Prior to delivery and installation of the equipment, certain utility or facility modifications may be required. Only work that is required to make the equipment operate is eligible to be funded as site preparation. Work generated for aesthetic or functional reasons will not be included in equipment site preparation projects but will be included in a major repair or minor construction project. The preparation of the site may include, but is not limited to, items such as:

(1) Secondary utility work necessary to connect the equipment to existing utility services within the building. This work lies between the primary entry or source within the building and the room in which the equipment is to be placed.

(2) Installation of air conditioning for equipment if the manufacturer's written specifications state that the equipment must be operated in an air-conditioned space and provide temperature or humidity parameters that cannot be sustained by existing air conditioning.

(3) Provision of false floors or platforms required solely for the operation of the equipment.

(4) Installation of required shielding for electromagnetic radiating devices such as x-ray machines and linear accelerators.

c. Most work eligible for funding as site preparation will be classified as "non-construction" (i.e., engineer's "M" cost account) by the Department of Public Works (DPW). The DPW is responsible for properly segregating and classifying all work.

3-4. PROJECT APPROVAL AND FUNDING PROCEDURES

a. The MTF must submit USAMEDCOM FORM 255-R. This Form will be used to justify all equipment site preparation submitted for USAMEDCOM funding. An approved DA Form 4283 showing DPW approval and cost summary is also required, along with a copy of the detailed cost estimate from the DPW showing the work items segregated into the various engineer work classifications: “K” Maintenance/Repair; “L” Minor Construction; and “M” Equipment-In-Place (site preparation).

b. Preplanning and coordination. The actual installation of equipment normally begins after receipt, acceptance, and issue of the item to the user; however, proper planning and preparation will be done before receipt so timely installation can occur. In most cases, site preparation should be planned and completed prior to the equipment delivery date. Early planning and coordination with the MTF Facility Manager and the DPW to determine a realistic date when site preparation will be completed will assist in establishing a delivery date for the equipment.

c. Reporting. The quarterly requirement for HSC Form 107-R is no longer required. The basic information concerning obligation, work progress, completion, and final cost will be accomplished via telephone/e-mail.

The USAMEDCOM ACSIE&FM POC for the USAMEDCOM FIB is
USAMEDCOM
ATTN: ACSIE&FM
Fort Sam Houston TX 78234
Telephone DSN 471-6441/210-221-6441

POC for Assistant Chief of Staff for Logistics (ACSLOG) is:
USAMEDCOM
ATTN: ACSLOG
Fort Sam Houston TX 78234
Telephone DSN 471-7119/210-221-7119

CHAPTER 4. MILITARY RADIOLOGY FUNCTIONAL ECONOMIC ANALYSIS

4-1. INTRODUCTION - MILITARY RADIOLOGY FUNCTIONAL ECONOMIC ANALYSIS

a. The future of military health care will be characterized by access to high-quality care at anytime, anywhere, with total integration of patient records to the health care process. These requirements have brought to the forefront the limitations of the delivery of radiology services. Availability and accountability of diagnostic images are hindered by single access to images and by manual storage. Military readiness is impeded by the lack of timely interpretations in the field and the constraints of a chemicals-based system. Access to care may also be restricted by the limited availability of radiologists, especially in remote locations.

b. Along with these limitations, several external forces are affecting delivery of radiology services. Increased regulatory oversight, TRICARE competition, managed care, and the downsizing of the DOD are just a few of the forces constraining radiology resources and altering health care delivery practices. The strategic direction of the Military Health System (MHS), the external forces influencing health care delivery, the limitations of film-based radiology, and the emergence of innovative technologies are all compelling reasons for change and contribute to the motivation behind this business process reengineering effort. The *Military Radiology Functional Economic Analysis* (FEA) (BPR1255047-035, September 4, 1996) represents the vision of the military radiology community that will effectively prepare DOD radiology services to meet the needs of MHS beneficiaries in the most effective and timely manner possible.

4-2. BUSINESS PROCESS IMPROVEMENTS FOR MILITARY RADIOLOGY

a. To facilitate the recommended business process improvements and the transition of military radiology to a digital environment, MTFs should work with the MMT-S. The USAMMA MMT-S and the Army PACS Program Management Office (APPMO) will ensure Army uniformity by providing guidance and consultation to Army hospitals before and during the implementation of digital technologies. Although radiology is the primary generator of diagnostic images, PACS could also be implemented to support other diagnostic imaging specialties (e.g., cardiology or dentistry). The archival and distribution requirements should not differ among diagnostic specialties. MMT-S will ensure that, before any equipment is installed at a site, the business process changes and expected benefits are clearly understood and accepted by the site personnel.

b. The radiology work group recommends several other business process improvements. These include new and modified radiology activities and extensions beyond the scope of the FEA. Of primary importance are the following:

(1) The monitoring of performance, business trends, and clinical practices. This function of monitoring performance, business trends, and clinical practices is best facilitated by the TARA program;

(2) The establishment of working relationships with non-DOD federal agencies;

(3) The retention of military radiologists; and

(4) Standardization of the use of the Current Procedural Terminology (CPT) coding system.

c. Two alternatives were defined to accomplish the recommended business process improvements.

(1) Continuation of analog, film-based radiology services. This alternative is based on the standard staffing requirements needed to meet current workload levels. Currently, there is a shortage of military radiologists. As a result of negative feedback and the unlikely prospect of increased staffing during military downsizing, this alternative was deemed unfeasible.

(2) Transition to digital radiology. This alternative enables the recommended business process improvements through the technologies previously discussed. The primary cost drivers of this alternative are PACS, teleradiology, telecommunications infrastructure, and voice recognition equipment. The anticipated monetary benefits estimated for this alternative include reductions in the costs for film, chemical purchase and disposal, file room clerks, technologists, and transcription services. Other monetary benefits could be realized in reductions in the costs associated with medical evacuations, file rooms, darkrooms, chemical capture devices, malpractice suits, and contract radiologists.

4-3. DIGITAL TECHNOLOGY

a. The radiology work group unanimously agreed that the transition from film-based, analog systems to digital data acquisition, storage, transfer, and interpretation is necessary to maintain an edge in the readiness of our military forces and to improve the quality of services provided to radiology customers. The DOD-developed MDIS system was the first tool used to accomplish this functionality. At the time of this functional analysis, the consensus of the radiology work group was that the commercial market for similar digital technologies was maturing. The group recommended that, although the DOD should continue to support installed MDIS systems and other current obligations, it should also seek less expensive solutions that used integrate, scaleable commercial-off-the-shelf (COTS) packages. The solution for digital imaging storage and distribution was the DIN-PACS contract awarded to Agfa and IBM. Modality compatibility with DIN-PACS is provided through compliance with the DICOM standards (see Chapter 8). Work is underway to develop the successor to the DIN-PACS contract. This subsequent contract will broaden the choice of vendors.

b. The recommended functional improvements enabled by digital radiology will strengthen the MHS push towards attaining designation as the benchmark health care delivery system. The unified front presented here will enhance the joint medical readiness capabilities of the MHS. The digital transformation of radiology will enable the seamless integration of health care technology and the patients' records. The military radiology community is unified in commitment to the fulfillment of the recommendations that lie within this document.

4-4. GOALS OF DIGITAL RADIOLOGY

a. To implement these improvements and others as well, digital radiology must become a reality. These improvements require immediate and simultaneous access to any image by those authorized to view and interpret diagnostic images. A Picture Archiving and Communication System (PACS) will facilitate acquisition, storage, and distribution of radiology images in a digital format. Teleradiology will enable this image management to take place among facilities, regions, and international boundaries.

b. The implementation of PACS and teleradiology will facilitate the real-time and simultaneous access to images by radiologists and providers. Unfortunately, radiology images represent only half of the equation. Adequate modality upgrades to meet digital requirements and DICOM conformance will provide a seamless interface between the modality and PACS. Transcribed reports must accompany each examination result. Voice recognition dictation systems will eliminate transcription backlogs as providers are enabled to dictate and verify reports without delay. In addition, enhanced telecommunication lines must be installed prior to implementation of teleradiology. The simultaneous and immediate availability of radiology images and reports will greatly enhance radiology services.

4-5. GOALS OF MILITARY RADIOLOGY

a. The goal of military radiology is to be the premier provider of top-quality radiology services to all DOD health beneficiaries in any situation or environment. To attain this goal, a radiology work group developed several objectives and performance measures. Although these objectives and measures encompass the cost, quality, access, and readiness of radiology services, a primary emphasis was placed on satisfying the customers, including patients, clinicians who request radiology services, and line Commanders, of the radiology department.

b. To successfully attain the objectives and meet performance measures, the work group defined several changes to the process and scope of radiology services. To improve image file availability and accountability and provider productivity, radiology must implement efficient image management by automating image storage and retrieval. To reduce wait times, eliminate unread exams, and improve provider satisfaction, military radiologists intend to provide "real-time" radiology services. Instead of the days or weeks that often elapse between a physician request and the transcribed diagnosis, radiology will provide immediate responses to all exam requests. A triservice radiology department will improve radiologist productivity and education through the redistribution of its workload within and among Tricare regions, thereby enabling greater access to quality services. This capability will also enable 24-hour on-line availability of radiology services to deployed forces. Decentralized radiology departments will improve responsiveness and consultative services as radiologists are physically relocated to specific high volume clinical locations. Similarly, centers of excellence will be developed to increase the use and effectiveness of consultations and second opinions. The result will be improved diagnostic accuracy and patient care.

4-6. RADIOLOGY PERFORMANCE MEASURES AND TARGETS

a. Performance measures are quantifiable indicators used to evaluate the effect of changes on functional processes. Managers typically use performance measures to gauge the amount, speed, quality, and cost of work done by an activity or function. These measures must be meaningful to the functional managers responsible for the activity. Furthermore, they must serve as indicators of the short-term impact of the business process changes and long-term contributions to the strategic direction of the MHS.

b. Sections 1 and 2 of FEA outline the goals of the MHS and the functional area of radiology. The radiology work group selected several performance measures that could be used to measure the degree of success in attaining those goals. Table 4-1 lists these performance measures, the means of capturing data for these measures, the current levels of performance, and a 6- to 10-year target. Local managers should use these and other performance measures to steer change within their organization.

c. The FEA cited a survey sent in April 1996 to 102 of the radiology sites. Responses to this survey were used to establish a baseline for several performance measures. Seventy sites returned the surveys. The mean, standard deviation, and confidence interval were computed for each radiology site type. The averages referred to throughout the remainder are for all responding radiology sites.

d. Several performance measures can be used as proxies for satisfaction, but unless they are specifically asked, it is difficult to know whether these critical stakeholders are satisfied. On the basis of a telephone survey to 12 randomly selected Army, Navy, and Air Force facilities, it is estimated that only about 47 percent of military radiology departments use provider-satisfaction surveys. The work group set as a target that all radiology departments survey a random sample of providers and patients to measure the performance of the department and to identify opportunities for improvement. The work group has developed satisfaction surveys for both providers and patients that can be used by radiology departments. These or other surveys can be tailored to site-specific needs. Once baselines

are established for the surveys, results should be compared from year to year, taking appropriate actions if a degradation in performance is recognized.

e. Sites were surveyed randomly to determine the extent of the use of American College of Radiology (ACR) standards and appropriateness criteria as department guidelines. ACR standards define specific guidelines such as radiation dose, personnel qualifications, and equipment specifications required for proper execution of radiology procedures. ACR appropriateness criteria specify the indications that substantiate the need for a radiological study. Both of these are designed to improve the quality and utilization of radiology services. The work group set as a target that every radiology department maintain a current copy of these guidelines, study their contents, and apply them as standards within the department.

f. From the Medical Expense Performance Reporting System (MEPRS) central database, the work group extracted radiology cost and workload data from 1990 to 1995. Data was pulled for the diagnostic radiology and nuclear medicine accounts. This measure includes all direct and indirect costs divided by total weighted workload reported in MEPRS. Through the course of this six-year reporting period, workload reporting has changed. After 1993, the relative value scale was adjusted, thereby greatly increasing the number of relative value units (RVUs) for a given set of procedures. Because of this, the group chose to analyze the trend of cost per RVU from 1990 to 1993 and again from 1994 to 1995. Through the course of these years, the cost per RVU has averaged an 8.6 percent increase per year. The radiology work group believes that the increase in this performance measure should not exceed the rate of medical inflation. In the past this rate has exceeded 10 percent; current projections indicate a 5 percent rate in the short-term future. Yearly MEPRS data can be used at the local, service, and DOD levels to measure success in attaining this performance measure. For this metric to be meaningful, reporting must be accurate and consistent between years. Therefore, 1996 should be used as the baseline, since CPT coding has recently been assumed as the workload recording methodology for all of radiology.

g. To ensure diagnosis accuracy, radiology departments must maintain and perform proper quality assurance procedures (e.g., quality reviews, including access to experts as well as earlier diagnosis). The work group chose to analyze diagnostic accuracy from the standpoint of medical malpractice claims. The Department of Legal Medicine maintains a database of military medical malpractice cases, including the allegations and case outcomes. The records indicate that, in the 1990s, $15,900,000 has been paid for claims related to radiology services. These claims are identified by specialty code "S," which is indicative of a radiologist or clinical service code DCA or DCB, indicating diagnostic or therapeutic radiology, respectively. Assuming that this is only 60 percent of the actual cases, radiology is likely responsible for approximately $26,500,000 in malpractice claims. Of the claims identified, 91 percent of the dollar value ($24,100,000) has been for diagnosis-related allegations. Sixteen percent of these ($3,860,000) have resulted from a delay in diagnosis. The work group believes that in the future there should be no claims attributable to a delay in diagnosis. Although they would like to eliminate all radiology malpractice claims, they have realistically set a target of a 50 percent reduction in the number and dollar value of other diagnosis-related claims.

h. Two sources were identified that specify the appropriate staffing levels for a given level of radiology workload.

(1) One, the *Joint Healthcare Manpower Standards Development Study,* was developed by the Joint Healthcare Management Engineering Team (JHMET) in August 1994.

(2) The other, *Productivity of Radiologists: Estimates Based on Analysis of Relative Values Units*, was developed by the ACR in December 1991.

Table 4-1. Performance Measures

PERFORMANCE MEASURE	SOURCE OF DATA	CURRENT PERFORMANCE LEVEL	SIX- TO 10-YEAR TARGET
Provider and Customer Satisfaction	Telephone Survey	47% of radiology depts. Utilize Provider Surveys; 94% of radiology depts. Utilize Customer Surveys	100% use for each
Standards Compliance	Telephone Survey	53% use ACR Standards; 47% use ACR Appropriateness Criteria	100% awareness and use
Cost per RVU	MEPRS Central (June 1995)	Average an 8.6% increase per year over the past 6 years.	Do not exceed rate of medical inflation
Diagnostic Accuracy	Department of Legal Medicine	$24.1M in diagnosis-related claims since 1990; $3.86M due to a delay in diagnosis	Eliminate claims attributable to a delay in diagnosis: cut all others in half
RVUs/Radiologist (proxy raw procedures)[2]	DMIS-SS MEPRS Central (June 1995) JHMET	14,815 raw procedures Non-GME; 8,803 at GME locations	12,316 raw procedures at non-GME sites; 7.919 at GME locations
Technologists and Support per Radiologist[2]	DMIS SS (June 1995) Survey	5.3 to 6.4 technologists and support personnel per radiologist	4.5 technologists and support personnel per radiologists
Report Turnaround[2]	Survey	2.5 days	One hour
Image File Availability and Accountability[2]	Survey	7.3% unavailable 2.9% unaccountable[1]	99.9% availability and accountability
Appointment Wait Time (days to available appointment)	CHCS	X-ray: 1 Mammo: 13 US: 10 Nuc Med: 4 CT: 6 Special: 6 MRI: 12 Angio/Inter: 3	Competitive with wait times at civilian facilities
Unread Examinations[2]	CHCS	Approximately 4.4% of exams are never read at 2 months[1]	All exams to be read
Fetch Time[2]	Expert opinion	2-20 minutes per search depending on location[1]	2 to 3 seconds per retrieval
Radiation Exposure	Digital equipment will measure	Not captured	Decrease by the reduction in repeat films
Technical Repeats[2]	CHCS	4.3%[1]	<1%
Medical Evacuations (MEDEVAC)	Bosnia Data	Not available	Eliminate Med Evacs for radiological reasons

ACR, American College of Radiology
CHCS, Composite Health Care System
DMIS-SS, Defense Medical Information System-Summary System
GME, Graduate Medical Education
JHMET, Joint Healthcare Management Engineering Team
MEPRS, Medical Expense Performance Reporting System
RVU, Relative Value Units

[1] These baseline measures are all significantly higher when accounting solely for larger radiology sites where the greatest number of procedures is performed.

[2]Data are for film-based performance and do not represent performance levels at PACS sites.

Both provide guidelines that specify the number of radiologists required for a range of total procedures and weighted workload. Both studies report consistent findings. The DOD has switched to the Medicare reimbursement CPT methodology for capture and reporting of workload data. Unfortunately, the RVUs previously reported in MEPRS are not the same as the Health Care Financing Administration RVUs reported using the CPT system. Accordingly, the work group chose to analyze raw procedures per radiologist (as opposed to weighted workload RVUs), as raw procedure counts provide a relatively stable measurement from year to year. Although variations in the complexity of workload may exist at a particular site, the overall case mix throughout the DOD will vary only slightly. According to the JHMET study, there should be one radiologist for every 12,356 procedures performed at a non-graduate medical education (GME) facility. A GME facility should have one radiologist for every 7,919 procedures performed. Workload data for 1995 from the MEPRS summary system and full-time equivalent (FTE) data from the Defense Medical Information System (DMIS) summary indicate that non-GME sites currently perform 14,815 procedures per radiologist and the GME sites perform 8,803 procedures per radiologist. These data indicate that military radiologists on average exceed workload targets and that the DOD is understaffed for radiology services. This represents another force for change identified by the work group.

i. The *Joint Healthcare Manpower Standards Development Study*, August 1994, estimated that approximately six technologist and support staff personnel should be available for every radiologist within a department. For facilities without a radiologist, one technologist is required for every 1,500 procedures. According to the radiology data collection survey and the DMIS summary, military radiology departments had on average 5.3 and 6.4 technologists and support staff, respectively, for every radiologist in 1995. Most sites are close to the established JHMET standard. The radiology work group predicts that changes in radiological technology will reduce the required support personnel. The work group has set the 10-year target at 4.5 technologist and support personnel for every radiologist.

j. Report turnaround time is the time that elapses between the execution of a radiology procedure and the availability of a transcribed report. Often clinicians spend days or even weeks waiting for the written interpretation before rendering a decision regarding the delivery of health services to a given patient. As reported in the radiology data collection survey, it takes 2.5 days, on average, before a transcribed report is available. The radiology work group has set one hour as a 10-year target for this measure. Reducing this time can significantly improve the quality of care.

k. The radiology data collection survey requested that each site obtain a random sample of 50 images obtained within the last year. Of those 50 exams, the sites reported the number of films that were unavailable. A film may be unavailable because it is checked out by a clinician, improperly filed, or lost. Sites were also asked to specify how many of the images were unaccountable (the location of the film was not known). Of the surveyed sites, 7.3 percent of the images, on average, were unavailable, and 2.9 percent were unaccountable. These figures are greater at large medical centers where the greatest number of procedures is performed. In a survey of 100 consecutive requests at the Naval Medical Center, San Diego, California, more than 20 percent of requested films were either lost or unavailable. Lost films are another factor in medical malpractice lawsuits faced by radiology departments. In addition, availability and accountability of radiology images and reports affect the timeliness and quality of care. The work group believes that the appropriate target should be at least 99.9 percent availability and accountability of images.

l. To be the provider of choice for MHS beneficiaries, the work group believes radiology services must be provided in a timely fashion. If military radiology services cannot be provided within the same time frame as civilian health care sources, business will be lost to civilian contracts. Radiology sites reported from Composite Health Care System (CHCS) the number of days until the next available outpatient appointment for each of the radiology modalities. An attempt was made to obtain similar data for civilian hospitals from the ACR. The data were not available. Instead, several Northern Virginia hospitals were called with the intent of scheduling an appointment for each radiology modality.

m. The surveyed sites that have CHCS available were asked to query this database for the number of radiology procedures performed during a two-month period. Of those procedures, they were asked to identify how many CHCS indicated as never having been interpreted. On average, 4.4 percent of the studies were never diagnosed. Some large hospitals exceeded a 20 percent unread exam rate. The radiology work group contends that if proper utilization is taking place, all radiology studies should be interpreted with a transcribed report. They have set as a 6-year target that all studies be interpreted.

n. Early results from the pre-MDIS installation study indicate that clinicians typically spend 2 to 5 minutes each time they search for an image file. These findings are reflective of smaller hospitals and clinics where exam counts and file rooms are smaller. At larger medical centers, it is estimated that 20 minutes elapse from the time a request is made at the front desk until the film is handed to the requester. Greater than 20 percent of those searching for films left without them according to a survey at San Diego Naval Medical Center. This time spent retrieving films can amount to several hours a week for high-use areas such as the pulmonary and orthopedic sections. The work group anticipates significant reductions in fetch time with the implementation of digital technologies. Electronic storage will likely enable access to any locally stored image within 2 to 3 seconds.

o. Film-based analog radiology does not provide a mechanism to monitor the degree and amount of radiation to which a patient is exposed; therefore, there is no baseline for radiation exposure. Digital systems provide the capability to capture the amount of radiation exposure for each exam. The work group believes a baseline measurement should be established for each exam and in the aggregate for each patient as digital imaging is implemented within the DOD. This would enhance the quality of health care by giving practitioners the ability to determine and avoid dangerous levels of exposure. This performance measure needs to be captured, monitored, and standardized for the various imaging modalities and exam types. The ACR guidelines previously discussed provide standards with respect to the levels of radiation not to be exceeded for the various exams. As a target, the work group suggests that radiation exposures be reduced by the equivalent reduction in the number of technical repeats.

p. Repeat films are the number of films of any given examination deemed to be of non-diagnostic quality. Among other things, this could include underexposure, overexposure, poor patient position, processing error, or equipment error. According to the surveyed sites, approximately 4.3 percent of radiology exposures are repeated because of one or more of these errors. This error figure is commonly in the 10 percent to 12 percent range for teaching facilities. Digital radiology should eliminate almost all repeat films attributable to the exposure or processing errors, which constitute most repeat films. They set one percent or less as a target for repeat examinations.

q. Lack of expert diagnosis in deployed military situations often requires that people or films be transported to ensure high-quality care. When this happens, an individual may be lost from service unnecessarily. In addition, it is a time-consuming and expensive process. The goal of military radiology is to eliminate all medical evacuations that occur because of the need for a radiological diagnosis. If the results of a diagnosis are positive, evacuation for health reasons is acceptable. The work group wants to avoid situations in which an individual is evacuated solely for radiological diagnosis. They also want to avoid the situation where the lack of availability of an appropriate diagnosis precludes the timely evacuation of patients from remote or deployed locations. This situation directly impacts the timeliness and quality of care received.

CHAPTER 5. TECHNOLOGY ASSESSMENT AND REQUIREMENTS ANALYSIS (TARA) PROGRAM

5-1. INTRODUCTION - TECHNOLOGY ASSESSMENT AND REQUIREMENTS ANALYSIS (TARA) PROGRAM

a. Background. The TARA program originated with a 1992 tasking by the Corporate Information Management group (later designated the Medical Functional Information Management group) to evaluate commercial capabilities for technology assessment and capital equipment asset management. This tasking led to the award of a pilot contract in January 1993 to conduct an initial evaluation of Ireland Army Community Hospital, Fort Knox, KY, in the areas of diagnostic imaging and laboratory. The product fell short of the program goals, and the decision was made, with the concurrence of the OTSG radiology consultant, to develop an in-house program.

b. During the remainder of 1993, the USAMMA MMT-S queried the technology assessment and asset management capabilities of several hospital systems and developed a composite program for AMEDD use (later designated the TARA program) that was first used at the Walter Reed Army Medical Center in April 1994. The STCPC formally adopted the TARA program in January 1995, directing full integration of clinical consultants and requiring a TARA visit to every AMEDD medical activity and medical center on a 3-year basis.

c. Process Improvements and Cost Avoidance. The radiology model of the TARA program has resulted in process improvements for requirements generation and delivery of services, expedited modernization of diagnostic imaging systems, and generated a cost avoidance of about $71-million for the AMEDD since 1995. To continue the success of the TARA program, value-added processes continue to be developed and refined.

d. Laboratory TARA. At the request of the USAMEDCOM, a TARA program for the laboratory area of MTFs was developed at the beginning of FY 1998 and integrated into the full TARA cycle. Benefits similar to those achieved with the radiology model were expected but not realized. After one year of applying the TARA model to laboratory processes, the TARA team determined that the laboratory model was most effective when applied only to medical centers. The TARA team recommends that medical centers consolidate, when practicable, as much laboratory testing as possible on high-volume analyzers and testing equipment. This may require sending testing that does not require a rapid turnaround from MTFs to the medical center within that RMC. The TARA team also encourages MEDCENs to consider and implement the concepts of laboratory automation. (Laboratory automation is discussed in Chapter 7.)

5-2. CLINICAL APPROACH AND BUSINESS PROCESS REENGINEERING

a. Radiologists who conduct the clinical component of the TARA site visit use the FEA *(BPR 1255047-035*, September 4, 1996) as a guide for comparing and gathering information. The FEA defines the ideal radiology support necessary to improve the cost, quality, access, and readiness of military health care services. The recommended functional improvements enabled by digital radiology will strengthen the MHS push toward attaining designation.

b. The JHMET sponsored by the Air Force Management Engineering Agency released in August 1994 the *Joint Healthcare Manpower Standards Development Study* that recommends approximately six staff personnel, including technologists, should be available to support each radiologist within the radiology department. For facilities without a radiologist or significant reception, clerical, or file room support, it is estimated that one technologist is required for every 1,500 studies. According to the radiology data collection

survey and the DMIS summary report, military radiology departments had approximately 5.3 to 5.7 technologists and support staff for every radiologist in 1995. Most sites are close to established JHMET standard. The radiology workgroup predicts that changes in radiological technology will reduce the required support personnel.

5-3. REQUIREMENTS FOR OPERATIONS AND EQUIPMENT

a. Equipment Utilization. The TARA team uses commercial equipment utilization factors, tempered by contingency issues unique to military hospitals. These utilization factors are applied to the facility's workload to determine how the hospital or clinic compares with commercial counterparts. This comparison does not imply that the hospital or clinic should be held to commercial standards. However, these utilization factors provide the TARA team benchmarks with which to begin the evaluation process. As shown in Tables 5-2 and 5-3, the TARA team used the following method to determine the ideal utilization (*U*) factors for each section of the radiology department: *U* = expected hours/year × studies/hour × ideal patients/year. The utilization factor represents the number of systems needed to handle the patient workload at the facility. These factors are only used as guidelines and can change from facility to facility, based on types of studies, mission, and the catchment area.

b. The productive use for diagnostic imaging equipment is based on the typical amount of time expected to perform a study, exam, or procedure. For example, an ultrasound study, on average, takes approximately 45 minutes, which equates to 1.33 studies per hour, as shown in Table 5-3. The productive use for clinical laboratory test equipment is based on the annual test volume divided by manufacturer's annual throughput. These numbers are then tempered according to hours of operation and test menu configuration. Calculations are instrument specific and can provide for a number of solutions depending on which make and models are used. Equipment focus is on what is currently in use, what is predominant within the region, and any equipment identified by the laboratory manager.

c. Once the number of hours per year and the use per hour are determined, the two are multiplied together to conclude the ideal studies per year. For example, with ultrasound, there are 2,000 available hours per year with 1.33 studies per hour, which equates to 2,660 ideal studies per year, as shown in Table 5-3.

Table 5-2. Diagnostic Imaging Hours Available

Modality	Expected hours used per day	Expected days used per week	Expected weeks used per year	Expected MTF hours used per year
Radiography*	4	5	50	1,000
Fluoroscopy	5	5	50	1,250
Mammography	8	5	50	2,000
Ultrasound	8	5	50	2,000
Nuclear Medicine**				
Computed Tomography	16	6	52	4,992
Magnetic Resonance Imaging	16	6	52	4,992
Clinic	8	5	50	2,000
Radiation Therapy	7	5	50	1,750
R/F Simulator	7	5	50	1,750

**Workload for period of peak utilization (usually 0730 to 1130).*
***Gamma cameras for nuclear medicine typically see 5 patients/day and are used 230 days/year for an annual total of 1,150 patients/camera/year.*

5-4. TARA CYCLE REVIEW

a. The radiology model of the TARA program has resulted in process improvements for requirements generation and delivery of services, expedited modernization of diagnostic imaging systems, and generated a cost avoidance of about $82 million since 1995 (Table 5-4). In addition, the laboratory model generated a cost avoidance of approximately $1.7 million in FY 1998. The direct cost avoidance from the TARA process is based on the removal of technology that is no longer required. The benefits from corrections in scope are gained when, after TARA review, requested technology is replaced with lower cost technology that is more appropriate for the clinical requirements and workload at the MTF.

b. During the first complete TARA cycle, about 40 Army MTFs were visited. (Since that time, the total number of facilities visited has reached about 60, including facilities of the Air Force, Navy, and Department of Veterans Affairs.) Overall, the radiology departments visited to date are generally well run and adequately equipped. There are, however, a number of systemic issues affecting efficient utilization and, ultimately, access to care.

c. Universally, facilities are short of clerical staff for the radiology department. This reduces the efficiency and throughput of the department because technologists spend significant time performing clerical duties (e.g., performing receptionist duties or entering patient data). In many cases, adequate clerical support will probably increase the department's overall productivity by 20 to 30 percent. It has been observed that some radiologists transcribe their own reports. This is, at the very least, an inefficient use of salary and contract dollars.

Table 5-3. Determining Equipment Utilization

Technology	Expected MTF Hours/Year	Studies/Hour	Ideal Patients/ Year	Current MTF Patients/ Year	Utilization
Radiography	3,000	4	12,000	A	A ÷ 12,000
Fluoroscopy	1,250	1.33	1,663	B	B ÷ 1,663
Mammography	2,000	2	4,000	C	C ÷ 4,000
Ultrasound*	2,000	1.33	2,660	D	D ÷ 2,660
Nuclear Medicine	1,840	1.6	1,150	E	E ÷ 1,150
CT**	4,800	2	9,984	F	F ÷ 9,984
MRI**	4,800	1	4,992	G	G ÷ 4,992
Clinic	2,000	5	10,000	H	H ÷ 8,000
Linear Accelerator***	1,750	4	6,500	I	I ÷ 7,000
R/F Therapy Simulator	1,750	1	1,750	J	J ÷ 1,750

**Calculations are based on actual management engineering time studies; each procedure has been assigned room productivity times. The exact time was based on industry information tempered by unique aspects of the DOD's medical operations and the operation of the local facility. The following example shows how this method was used to derive the equipment utilization factor for ultrasound.*

Equipment	*Ultrasound*
Hours available per year	*8 hours/day × 5 days/week × 50 weeks = 2,000 hours/year*
Productive time	*1.33 study/hour (60 minutes/study for MEDDAC/MEDCEN)*
Ideal studies per year	*1.33 study/hour × 2,000 hours/year = 2,000 ideal studies/year*
RMC studies per year	*4,500 studies/year*
Percentage utilization	*4,500 studies/year ÷ 2,660 ideal studies/year = 1.7 systems*

***MTF hours of operations and number of studies per year for CT and MRI are based on DOD standards*.
****Linear accelerator is number of treatments, not patients (most patients require a number of treatments), and rounded down to reflect complexity of some procedures that require additional time on the machine.*

d. Based on technologists' interviews and CHCS and Military Interdepartmental Purchase Request (MIPR) reports, the number of studies, patients, or exams per year for the facility is determined. This number is then divided by the ideal number of studies, patients, or exams per year to determine the final utilization requirement or the proposed number of systems that the department should have. For example, with ultrasound, a hospital seeing 4,500 patients per year will have a utilization of 1.7 or 2 systems.

Table 5-4. TARA Program Cost Avoidance to Date

Fiscal Year	TARA Direct (Radiology)	Corrections in Scope (Radiology)	Laboratory Direct
1994	$10,975,000	$1,097,500	NA
1995	$14,553,250	$1,455,300	NA*
1996	$11,455,700	$1,145,570	NA
1997	$3,289,000	$328,900	NA
1998	$3,959,000	$395,900	$1,677,750
1999	$4,059,100	$405,910	$688,000
2000	$3,683,800	$368,380	$117,000
2001	$560,000	$56,000	NA
2002**	$425,000	$42,500	
Total	$52,959,850	$5,295,960	$2,482,750

Since program inception, combined total cost avoidance for TARA program is approximately $61,000,000.
**Laboratory assessment was conducted only in FY 1998 at all TARA site visits.*
***FY not completed.*

d. Most facilities have a greater equipment density than is necessary to meet their workload. This is to be expected in a downsizing environment. Put simply, there are fewer customers. However, in many cases, this excess capacity may be justified based on mission profiles that include deployment.

e. Some recurring equipment problems can be traced to the utilities. This can add equipment requirements to accommodate for unanticipated downtime. Insufficient ventilation in one facility's nuclear medicine department generated so much drift in the detectors that the systems had to be re-calibrated two or three times per day. This meant that every system in the department was only available for use about half of the time. In several other facilities, cooling problems attributed to frequent shutdowns of the computed tomography (CT) scanner because of heat-loading problems on the x-ray tube.

f. In the case of analog fluoroscopic systems, most facilities have excessive downtime attributable to problems with the imaging chain and spot-film devices, requiring them to have at least one backup system to accommodate their workload. The conversion

to digital technology eliminates this mechanical complexity and should improve the reliability of the systems making backup systems no longer necessary. The point here is twofold.

(1) Requirements should not be approved based solely on the fact that a facility is replacing an existing system.

(2) Workload, maintenance, and facility considerations change periodically and should always be evaluated in the approval process. In addition, staffing, facilities, and maintenance services are an integral part of any diagnostic imaging "system" and materially affect the facility's requirement.

g. Military radiology faces challenges in providing high-quality health care for all Armed Forces personnel and other beneficiaries within a changing military medicine environment. The goal of military radiology is to achieve the readiness capability required by military commands, to maximize the value of its health care services, and to promote a coordinated, collaborative Tri-Service approach to radiology. Several constraints affect the ability of the MHS to successfully fulfill the requirements of this goal, and with current limitations and changes in the health care environment, military radiology must prepare for the future.

h. The conversion to digital technology enhances efficiency and improves access to services. The proliferation of digital acquisition and processing devices and, ultimately, "filmless" hospital archive and teleradiology systems such as DIN-PACS is necessary to meet the MHS objectives outlined for radiology such as reducing report turnaround times and improving image accountability. Analog fluoroscopy systems should be replaced with digital systems. Networking of ultrasound and nuclear medicine systems to modality processing systems enhances clinician and technologist productivity. Establishing this network also reduces life-cycle costs by extending the life expectancy of the systems and allowing relatively inexpensive software upgrades in lieu of expensive hardware replacement. Digital technology is now more standard of care than emerging or state of the art, and few vendors still produce analog systems.

i. The military radiology community recognizes both the need for change and the opportunities for change that exist and has undertaken the corporate information management business process reengineering (BPR) effort (results published in *the FEA, BPR 1255047-035*, September 4, 1996). Rather than focusing on a specific technological solution, the goal of this effort is to streamline radiology activities and processes. The future of military health care will be characterized by access to high-quality care anytime and anywhere with total integration of patient records. These requirements magnify the limitations of current radiology services.

5-5. THE TARA PROCESS

a. The on-site evaluation of current technology and management operations within the radiology and clinical laboratory departments is performed by OTSG radiology and laboratory consultants or their representatives and personnel of the USAMMA MMT, to gather information and validate previously submitted data. The purpose of the site visit is to interview departmental staff, observe scheduling and patient-flow patterns, and evaluate quality of service and the condition and utilization of existing equipment. The TARA provides an unbiased review of the clinical processes, requirements, operations, and equipment for diagnostic imaging and clinical laboratory at the facility. The goal is to provide senior decisionmakers with the management information needed to make informed decisions on the clinical and technological resources required to accomplish business plan missions and to develop acquisition strategies that ensure optimal clinical outcomes. The mission is to ensure that diagnostic imaging equipment within the AMEDD remains on the established technology curve. Although state-of-the-art technology is expensive, over the long run benefits generally exceed the acquisition cost.

b. The TARA site visit consists of four major components.

(1) Assessment of clinical operations. The assessment is a clinical functional review by OTSG specialty consultants or senior clinicians. The functional review generally focuses on staffing, customer service, quality and risk management, patient flow and management, appropriate functional task performance, and integration with other care issues/areas. This review incorporates clinical input from the assessed facility with respect to workforce design, functional success, and mission, and compares the functional operation to accepted practice models. As a full AMEDD functional review, this evaluation also addresses leader development, training, and other military-relevant management issues.

(2) Assessment of requirements. Commercial, for-profit equipment utilization factors tempered by contingency issues unique to military hospitals are applied to the facility's workload to determine how the MTF compares with commercial counterparts. This comparison does not imply that the MTF should be held to commercial standards. However, these utilization factors provide the TARA team with benchmarks to begin the evaluation process.

(3) Assessment of operations. This includes an evaluation of procedural mix, staffing, work schedule, patient flow and throughput, and quality assurance and risk management to the extent that these factors apply to the acceptability and appropriate use of existing equipment.

(4) Assessment of equipment. This evaluation assesses whether the facility's existing equipment uses abandoned or obsolete technology and whether the equipment meets standards for acceptability. The assessment includes a market survey of current technology, a comprehensive evaluation of existing equipment, an evaluation of trends and developments that will affect diagnostic imaging and laboratory requirements at the MTF, and contract information where pertinent. The evaluation may include telecommunications equipment to determine if the existing infrastructure will support new teleradiology initiatives.

c. A TARA provides a snapshot of the facility's diagnostic imaging and clinical laboratory processes for the period during which the site survey was conducted. However, the TARA is not intended as a substitute for the facility's own routine evaluation of their operations. Because changes in a facility’s strategic vision could alter diagnostic imaging or laboratory requirements, the requirements for the MTF should be periodically reevaluated, especially in the event of a major change in mission.

d. The following information related to diagnostic imaging equipment will be requested and required prior to the site visit:

(1) CHCS data for the number and type of procedures performed annually, workload data for the last three to four years showing trends, and patient numbers for each modality;

(2) AMEDDPAS maintenance histories for diagnostic imaging systems in the radiology department. This should include, if applicable, imaging systems elsewhere in the hospital such as the urology or the obstetrics/gynecology sections;

(3) Business plan, if available, addressing services currently provided and services to be initiated or discontinued, including supplemental care expenditures for radiology;

(4) Patient demographics for catchment area;

(5) Blueprint or diagram of radiology department;

(6) Staffing information including authorized positions and actual staff numbers; and

(7) Plans, diagrams, or descriptions of existing telecommunications and networking infrastructure.

e. The following information related to laboratory equipment will be requested and required prior to the site visit at medical centers:

(1) Current property listing for all laboratory equipment and maintenance histories for all major laboratory equipment in the facility and any outlying clinics;

(2) Organizational chart;

(3) Blueprint or diagram of laboratory department;

(4) Capital Expense Equipment Program (CEEP) replacement list;

(5) TDA for pathology, including actual staffing numbers and names by department;

(6) Contract information with cost data for major equipment, including whether the equipment is cost per test, leased, or purchased;

(7) Cost data for major equipment for supplies and consumables by month and year;

(8) Copies of workload detail statistics reports on a floppy disk or as e-mail attachment, with data broken down by month for the past 12 months;

(9) A copy of the facility's laboratory manual; and

(10) MEPRS reports for at least the last two quarters although MEPRS reports for the past entire fiscal year are preferred. The reports should include the computational summary indicating direct expenses, support costs, and ancillary costs, for a minimum of the last two quarters and the step-down assignment statistics reports.

f. The following information related to network management may be requested prior to the site visit:

(1) Network topology, including information on voice, data, major vendors for local area network (LAN) hardware, and upgrade plans and schedules, if any.
(2) Bandwidth to desktop and bandwidth of the backplane and percentage of bandwidth in use during typical network loads.
(3) The network protocol, i.e. asynchronous transfer mode (ATM) or Ethernet.
(4) The clinics on base or in remote locations, if any, the network supports and connectivity to the clinics.
(5) What major routers are in place and what networks do the routers interface?

g. Information on the wide area network (WAN), including what data is being carried on it.

h. The TARA will request that the facility dedicate a classroom or conference room for use during the visit for meeting and storing equipment. In addition, if required by local regulations, visitor badges should be provided on arrival or during the in-brief.

5-6. TARA SCHEDULE

The tentative TARA schedule for FY 2002 through FY 2003 is in Table 5-1. If the Command at an MTF feels that TARA assistance is needed between scheduled site visits, assistance visits can be scheduled and coordinated at the Command's convenience. The TARA Team keeps the up-to-date schedule at www.armymedicine.army.mil/USAMMA/TARA/tara-sched.htm

Table 5-1. Tentative TARA Site Visit Schedule, FY 2002 through FY 2003

Month	Facility
FY 2002	
January 2002	Walter Reed Army Medical Center
March 2002	Fort Belvoir (North Atlantic Region)
May 2002	121st General Hospital, Korea, and supporting clinics
June 2002	Landstuhl AMC, Weurzberg MEDDAC, and Heidelburg MEDDAC
August 2002	Fort Meade (North Atlantic Region)
FY 2003	
October 2002	Fort Knox (North Atlantic Region)
January 2003	West Point/Fort Drum (North Atlantic Region)
March 2003	Tripler Army Medical Center
April 2003	Fort Eustis (North Atlantic Region)
April 2003	Fort Lee (North Atlantic Region)
June 2003	Womack Army Medical Center
August 2003	Brooke Army Medical Center

5-7. TEAM APPROACH FOR TARA

a. Currently, the TARA team consists of a radiology consultant and a laboratory consultant from OTSG and a group from the USAMMA. The USAMMA group contains specialists in biomedical/clinical engineering, medical physics, laboratory, and maintenance from the USAMMA MMT-S.

b. All of the members of the TARA team are present for the on-site MTF assessment. This team approach is necessary given the large amount of information that must be collected, organized, and analyzed. The preliminary analysis is presented to the commander during the out-brief to provide the "snapshot" as close to the time it was taken as possible. This can only be accomplished when all members are present and provide their input prior to the out-brief. A formal report follows within six to eight weeks.

c. The maintenance portion of the TARA team is necessary to evaluate the MTF's equipment. Relatively new equipment with extensive unscheduled maintenance must be considered for replacement along with older technology. Outsourcing of maintenance contracts and the impact that has on the availability of the device must be assessed. The goal is to maximize the availability of diagnostic equipment, so that it may be used by the clinician. Assessment of the maintenance support of that equipment is extremely critical to achieving that goal.

d. The biomedical engineering component applies to both the laboratory and radiology areas. They provide expertise in the area of equipment evaluation, but they are also responsible for the development of acquisition strategies for new and emerging medical systems within their sub-specialty.

CHAPTER 6. COMBAT SUPPORT EQUIPMENT ASSESSMENT (CSEA)

6-1. INTRODUCTION - COMBAT SUPPORT EQUIPMENT ASSESSMENT (CSEA)

a. The MMT-S has established a standardized methodology for assessing, planning, and acquiring technology within the AMEDD and DOD MTFs. Benefits gained through the application of the TARA process are applied to TOE MTFs. This application of the technology assessment process to deployable MTFs is designated the CSEA.

b. The medical reengineering initiative (MRI) and Medical Communications for Combat Casualty Care (MC4) are top priority, and the USAMRMC requires an evaluation of the capability of our TOE units to receive these technologies. The CSEA process is an excellent evaluation tool for assessing the military unique requirements for medical equipment in the TOE environment.

c. The CSEA process incorporates factors regarding the TOE environment into account when making a technology assessment. The equipment is deployed to an environment where it may be exposed to environmental extremes. The electro-magnetic "footprint" (both conducted and radiated emissions, as well as susceptibility to interference) must meet stringent requirements. Availability of utilities such as water or electricity is considered. Power fluctuations from a field generator are analyzed for their impact. The equipment must be reliable and maintainable because of the remote location of the equipment far from a service or repair center.

6-2. DEPLOYABLE MEDICAL SYSTEMS (DEPMEDS) - BACKGROUND

a. The current policy on DEPMEDS is to ensure maximum standardization, increase efficiency, and minimize costs. Ongoing objectives include the following:

(1) Reduce duplication of efforts in preparing for field medical operations
(2) Achieve maximum standardization of medical and non-medical materiel
(3) Promote the coordination, exchange and critical evaluation of information
(4) Provide a forum for the discussion and resolution of differences.

b. The desirable characteristics of the DEPMEDS are:

(1) Ability to provide current quality care;
(2) Affordability;
(3) Maintainability;
(4) Portability;
(5) Modular design for ease of incorporation into a variety of service-specific configurations;
(6) Usability by all four services, and
(7) Ability to be strategically airlifted.

c. This standardization program was extended to the development of new DEPMEDS such as the Army 30-bed mobile army surgical hospital (MASH), the Air Force air-transportable hospital (ATH), and the Marine Corps Medical Battalion.

d. The original DEPMEDS Medical Materiel Sets and their combination by each service to form field MTFs, supported our Armed Forces in combating the Soviet threat in Europe and around the world. The threat has changed to less intense conflicts and humanitarian and disaster relief. As a result, the military services are developing smaller and lighter deployable systems and augmentation sets. With the introduction of the single integrated medical logistics manager during Operation Desert Shield, the need for materiel standardization became paramount. The number of items to be supported in a theater of operations has to be kept to a minimum if the integrity of the logistics and supply pipeline is to be maintained.

f. Standardization of DEPMEDS systemically ensures modern, effective care and treatment in even the most arduous and demanding settings. There is no compromise in quality of care or treatment within the control of the medical system. The term "austere but adequate" was used in the past, but there was much debate about what that phrase really meant and what it entailed. While the spirit of "austere but adequate" was well-intended, it inaccurately implied willing acceptance of a compromise. DEPMEDS are designed to be effective and to meet modern standards of medical care. The only limitations on care are those imposed by tactical or transportation limitations, not by system design or policy.

g. Currently, DEPMEDS sets contain analog radiology and laboratory capability. To meet the objectives of the MHSS, the *Military Radiology Functional Economic Analysis* (FEA) stated that the DOD must transition from analog to digital image acquisition, storage, and transfer. Analog systems are characterized by poor film availability and accountability, lengthy response times (for both clinician and patients), and the generation of hazardous waste.

h. In addition to direct cost implications, analog systems negatively affect deployability, quality of care and access to care, and may increase malpractice risk. To support these objectives and other digitization initiatives, future equipment purchases or upgrades must support current digital imaging standards, and the radiology department must be re-engineered to incorporate digital imaging.

6-3. MARKET INVESTIGATION AND MARKET SURVEILLANCE

a. Market investigation and market surveillance is the responsibility of the USAMMA MMT-S. The intended audience is clinical subject matter experts from all services and decision-makers within the USAMEDCOM (e.g., USAMMA leadership, MRMC Headquarters, and the AMEDDC&S Combat Developer). Market investigations and market surveillance must be accurate because of their use in the decision-making process. These decisions are the basis for the procurement of large quantities of medical equipment.

b. The USAMMA finds itself faced with replacing equipment from a range of categories. Currently, 4 medical and 19 nonmedical items are no longer sustainable or maintainable and must be replaced. An additional 53 ALSI items are sustainable only for a limited time through the National Maintenance Point, USAMMA. More items that are nonsustainable or nonsupportable may be identified. Because the availability of funds often is a limiting factor, it is important that we define specific requirements and have a clear understanding of the potential costs involved in conducting a product comparison/market survey of this nature.

6-4. NONSUPPORTABLE, NONSUSTAINABLE, AND OBSOLETE ITEMS (NNI) OF EQUIPMENT AND AMEDD LIMITED SUPPORT ITEMS (ALSI)

a. The USAMMA has formed an integrated process team to address nonsustainable/ nonsupportable equipment. The mission of the integrated process team is to develop an integral process that will provide a list of NNI equipment and associated items and develop short- and long-term replacement plans for these items (both medical and non-medical).

b. The term NNI is defined as equipment for which one or more of the following apply:

(1) The original manufacturer no longer manufacturers the item.
(2) Accessory, repair parts, and support items are not available.

Sixty-two Medical Materiel Sets and 329 types of devices were reviewed and originally, 57 items were designated NNI.

c. After further analysis, a second category of NNI items was created — AMEDD Limited Support Item (ALSI). It was determined that NNI will only refer to items that can no

longer be supported by any source, and ALSI will refer to items that can be supported for a limited time through the USAMMA Maintenance Engineering and Operations Directorate. Currently, four items are classified as NNI and 53 items as ALSI.

d. The MMT-S has developed a program that addresses not only the current list of NNI equipment but also performs medical equipment assessments to anticipate the replacement of future NNI equipment. One of the requirements of this program is ongoing market investigation and market surveillance to stay abreast of changing medical technologies. The specific goal is to conduct surveillance and evaluation of new and emerging technology for deployable MTFs and ensure the appropriate clinical proponents are advised of findings and recommendations.

e. The USAMMA identifies the combat developer's requirement in the program objective memorandum (POM) that defines where money will be spent. The POM is a budget request and is prepared three years in advance. When money becomes available, a requisition for the item is submitted to the Defense Supply Center, Philadelphia (DSCP). DSCP prepares contract specifications using essential characteristics and obtains the item. The effect of this three-year planning is that items identified and agreed on are not purchased for almost 5 years. In today's environment, the Army runs the risk of acquiring legacy technology. If medical practice has changed and a specific device is no longer needed, the Army runs the risk of failing to clinically integrate the requirement process during a reevaluation phase.

6-5. OTHER RESPONSIBILITIES IN THE TOE ENVIRONMENT

a. The CSEA focuses on assessing the capability to accept new and emerging technologies from MRI, MC4, or other initiatives. To support this, other responsibilities of the CSEA team include the following:

(1) Provide technical guidance, assistance, and instructions to field medical units for resolving medical logistics problems.

(2) Assist field commanders and materiel maintenance managers in identifying and resolving medical logistics problems that affect medical logistics readiness.

(3) Collect, correlate, assess, and disseminate medical equipment information required to respond to problems from the materiel, fielding, or system users.

(4) Recommend the appropriate equipment to be authorized in medical equipment and medical materiel sets.

(5) Support the goals of the Logistics Assistance Program (LAP).

(6) Ensure field medical units are aware of current medical policies, procedures, regulations, and management techniques associated with equipment maintenance requests.

(7) Assist commanders in determining the appropriate medical maintenance support for the maintenance program through the AMEDD National Maintenance Point, USAMMA.

(8) Visit other organizations providing medical logistics support to field medical TOE units.

(9) Evaluate the adequacy of medical equipment to perform missions and functions in accordance with the Combat Developer's requirements.

(10) Provide a vehicle for accomplishing follow-on evaluations for newly fielded or modified medical equipment items for deployable assemblages.

6-6. SUPPORT FOR DEPLOYABLE MTFS

a. All medical equipment fielded to TOE units has a life expectancy. It is the USAMMA's responsibility to track items fielded at different times and ensure the MTFs have the equipment needed to accomplish their mission. For example, DEPMEDS was fielded in the mid-1980s. The equipment initially fielded with those systems is now reaching obsolescence or becoming difficult to support.

b. Modernization and sustainment requirements for echelons II and III are a continuous process. The TOE CSEA considers the medical reengineering initiatives, patient movement items, medical detachment/telemedicine, and other AMEDD initiatives. The purpose is to provide the AMEDD with the information to make the best business decisions with constrained resources.

CHAPTER 7. MANAGING TECHNOLOGY IN THE MILITARY LABORATORY

7-1. INTRODUCTION - MANAGING TECHNOLOGY IN THE MILITARY LABORATORY

a. Health care initiatives have mandated that military laboratories begin to look at the way they do business to ensure the highest quality health care be provided in a timely manner. The USAMMA has been tasked to look at their business operations in comparison to the commercial counterparts and provide improvements. In some aspects this method has been effective, but in others there are military issues that cannot be addressed by comparing operations with the commercial sector.

b. Contracting methods have been developed in the commercial sector that can be taken advantage of by military laboratories. These new ways available for equipment and supply contracts allow the laboratories to keep up with the latest developments in technology, which was difficult to accomplish previously when facilities were purchasing equipment.

c. Issues that are not addressed include military readiness and training and the high turnover of military personnel that affects the efficiency of the laboratory. These issues have an impact on staffing and equipment configuration as they relate to workload. It is necessary to develop benchmark indicators other than the commercial benchmarks to properly look at the operations of military laboratories.

d. After the first year of applying the TARA process for laboratory, the TARA team determined that the process could most effectively be applied and the greatest cost avoidance realized at Army medical centers. Beginning with FY 1999, the TARA for military laboratories was not used at medical activities with lower volumes of laboratory testing. To maximize effective use of high-volume analyzers at medical centers, the TARA team suggests that testing that does not require a rapid turnaround be consolidated in each RMC at the medical center to the extent practical. This consolidation will ensure that high-volume analyzers at the medical centers operate as cost-efficiently as possible and allowing in some cases removal of underused equipment at medical activities.

7-2. DEVELOPMENTS IN PAP SMEAR TECHNOLOGY

a. Pap smear techniques for early detection of cervical cancer were introduced in the 1950s. As a result of these techniques, the mortality rate for cervical cancer has significantly decreased, and Pap smear techniques are widely used. The most common reason that cervical cancer goes undetected until the later stages is that women do not get routine Pap smears. Even with this success, the smear is not 100 percent accurate, and in some cases a false-negative diagnosis can occur.

b. This false-negative diagnosis can be attributed to any of the following during the Pap smear procedure:

(1) Sampling and slide preparation: Methods used to retrieve the sample involve scraping or brushing the cervix with a collection device and then transferring the cells to a slide. Although this is really the only method of obtaining cells, the transfer process can lose up to 90 percent of the cells taken from the cervix.

(2) Slide review and recording: The cytotechnologist who reviews a Pap slide needs to properly cover the entire slide and document any abnormal cells for review by a pathologist. Although this process is important, it becomes tedious, and the technologist can easily miss cells or sections of the slide without a tracking system to annotate what portions of the slide have already been reviewed.

(3) Negative slide rescreening: The College of American Pathologists mandates that at least 10 percent of negative slides be rescreened. Although this requirement has improved the quality of health care, it is still only a 10 percent rescreening, and some false-negative slides are not rescreened. Some facilities rescreen more than 10 percent, and some do selective rescreening. Selective rescreening involves cases where there may be a history of cancer or other risk factors that increase the chances of cancer in the patient; 100 percent rescreening would be ideal but staffing issues often make that objective difficult to obtain.

c. The issues have been addressed by the industry, and alternatives are available. Although some false-negative findings are inevitable, alternatives such as automated slide preparation, video-tracking microscopes, and total automation of the screening process can reduce the percentage.

d. Automated slide preparation has been developed to ease the workload on the technologists and provide for standardized slide view. Computerized microscopes have been developed to track the screening pattern for every slide and the time spent on each slide. Total automation has been developed to identify slides in which screening or rescreening needs to be performed whether on the slide or through identified video images.

e. Automated slide preparation provides for liquid-based cytology/monolayer slides that are easier to screen. Computerized microscopes are useful for cytotechnologists who are new and do not have an established routine for screening slides. Once the technologist is accustomed to screening slides and knows his or her limits, this technology may not be necessary. Totally automated systems are now available. This method of testing will only be beneficial at larger, high-volume sites. Unless Pap smear testing is consolidated among sites, Army facilities do not have the volume to justify this technology.

f. Product information on what is available on the market is maintained at the USAMMA. The MMT-S will continue to monitor developments in improving Pap smear procedures and assess appropriate technology.

7-3. EQUIPMENT CONTRACTING FOR THE LABORATORY

a. The USAMMA MMT-S maintains a database to track the different contracts and contracting methods available for laboratory equipment. When replacing the major analyzers, all methods of contracting for analyzers should be considered. The technology for the major analyzers is continuously improving and a capital investment in these types of analyzers is not always prudent. These analyzers can become obsolete within a couple of years or test menus can change and the return on investment would be low. The high supply costs for these analyzers should also be considered. Once the instrument is purchased, the facility needs to continue expenditures on supplies. Some contracting methods incorporate expenditures and supplies in the rental costs.

b. There are three different methods of acquiring laboratory equipment.

(1) The traditional contracting method is purchasing equipment. This method is valid when acquiring equipment that is low in cost or has a long life expectancy, both in terms of useful life and technology obsolescence. Examples of this type of equipment in the laboratory would be microscopes and centrifuges. A number of government contracting agencies keep central contracts for this type of equipment to achieve volume discounts. The General Services Agency (GSA), Department of Veterans Affairs National Acquisition Center, or the DSCP have contracts available. In other cases, the facility can contract on their own to purchase equipment. In the case of purchasing equipment, procurement dollars will be used for both CEEP (less than $100,000) and MEDCASE (more than $100,000) equipment. CEEP purchases will be funded by the facility, whereas MEDCASE purchases are funded centrally through the USAMEDCOM.

(2) Reagent rental contracting is based on leasing the equipment for a monthly fee that can be very low with the guarantee that the MTF will buy a certain volume of reagents

from the company. Contracting for this method is usually done individually by each facility with the vendors. Although this avoids the high initial expenditure and considers the cost of supplies, in most cases the equipment is then owned by the facility at the end of the lease term. Again this does not consider new technological developments, changes in mission, obsolescence, or facility needs.

(3) Cost-per-test is similar to reagent rental in that it is based on purchases of reagents or supplies for the analyzers. The difference is that the equipment is owned by the vendor and can be upgraded or turned in at the end of each contract year. Cost-per-test contracting is based on annual workload, and vendors work with the facility to determine what equipment configuration is appropriate for their workload and mission. A number of regional cost-per-test contracts with different vendors exist that offer volume discounts. Prices vary in accordance with the volume, percent utilization of a specific vendor's equipment, type of service contract and equipment and configuration within the facility. Contracts are done either through a central or regional government-contracting agency. The database maintained by the USAMMA MMT-S includes clinical chemistry analyzers, immunoassay analyzers, urine analyzers, hematology analyzers, coagulation analyzers, microbiology analyzers, and other cost-per-test instruments available.

7-4. LABORATORY AUTOMATION

a. Automation in the laboratory can occur at different levels from a single instrument to a work area to the entire laboratory. The higher levels of automation will incorporate the technology of the lower levels at different scales. Test mix and volume as well as operations and management of the laboratory department will determine the appropriate level of automation for a facility.

b. Single instrument automation is applicable to almost any facility that is performing testing in house. Automated analyzers are known for their "walk away" operations. The technician can load the analyzer with bar-coded samples, and the analyzer will automatically perform the tests while the technician leaves to perform other duties. Most Army MTFs that perform laboratory testing, with the exception of some of the smaller outlying or troop medical clinics, will have some type of automated analyzer.

c. Total laboratory automation is the automation of all aspects of clinical pathology from specimen receipt to result reporting. In most cases, all automated analyzers are arranged in a track system that routes the bar-coded specimen tubes to the designated analyzers for tests to be performed. This process can eliminate a significant percentage of the staffing requirements of a laboratory. At the initial stages in the development of total laboratory automation, there was great market interest in adopting this process. As more facilities have investigated this process, it has been found that the greatest benefit can be achieved at large facilities performing high volumes of testing, up to 10 million aliquots per year. This high volume can be found at an 800- to 1,000-bed facility that is also receiving specimens from other facilities or at a commercial reference laboratory that supports nationwide operations. No Army facilities currently have a volume high enough to justify incorporating total laboratory automation. In the future, a DOD reference laboratory may be the place to consider total laboratory automation. However, as the majority of testing stays within the different medical centers and medical activities, testing volumes do not warrant total laboratory automation and currently is not a recommendation for any military facility.

d. Although total laboratory automation is not right for all facilities, many facilities are finding that there is potential in automation beyond that of the single automated analyzer. As a modification to total laboratory automation, work area automation has evolved. Work area automation takes a section of the laboratory and automates the processes within that section. The greatest benefit for work area automation has been achieved in the chemistry and hematology areas of the laboratory. A section can be arranged in a track mode similar to that of total laboratory automation where the laboratory worker takes the bar-coded specimens and places them on sample holders to be delivered to the various workstations. The

workstations can then be set up to perform all designated tests, reflex any samples that do not meet a determined algorithm, and flag any specimens that may need manual testing. This takes the concept of total laboratory automation and uses it on a smaller scale. There are potential reductions in FTE requirements as well as increases in efficiency and reductions in manual handling.

e. In addition to automating test-work areas, pre-analytical stages also can be automated as part of this work area automation concept. In many facilities, specimen delivery and processing has been automated, benefiting the pathology department. Specimen delivery can be automated either through a pneumatic tube system, through a robotic delivery system programmed to perform any ward pickups as well as making programmed stops at all the different testing areas in the laboratory, or both. Automation of specimen processing can increase efficiency and decrease errors as a result of manual handling as well. Specimens that have been bar coded can be loaded into a modular system that reads the bar codes and sorts the specimens by the work area that will perform the tests. For specimens that need to be spun down, the modular system can be sent through a track system to a large centrifuge and spun before delivery to the work area.

f. Work area automation seems to be the best fit for Army facilities with high workload volumes. Costs will be much lower than that of total laboratory automation. The work cells can be designed around the current footprint of most facilities as opposed to reconstructing departments for total laboratory automation. FTE requirements can still be decreased within each work area.

g. Other issues exist that need to be addressed in considering robotics and automation. The first is determining what the workflow philosophy will be, depending on the needs of the laboratory. The second issue is looking at the preanalytical stage. Should that stage be automated, and if not, what needs to be done in this stage to accommodate the automation of other sections of the laboratory? A third issue is determining which areas can benefit the most from automation. The laboratory manager should consider areas where there is a high volume of repetitive functions that require little thinking. If the facility is performing a high volume of routine chemistry but a low volume of special chemistry, it makes more sense to automate only the routine chemistry area. If there is a high volume of testing in an area but there is a lot of technologist interpretation involved, perhaps it would not be effective to automate this area. It is important to automate the work that requires little user interface. The tedious tasks that are being done by technologists should be automated so that these employees can be used more efficiently and appropriately.

7-5. MILITARY LABORATORY BENCHMARK INDICATORS

a. The laboratory benchmark indicators are collected at each facility. These indicators are collected at all MEDCENS during the TARA visit and are being collected centrally by the office of the MEDCOM Laboratory Program Manager for all other MEDDACS. The indicators from the different facilities will be used to establish peer groups based on relative case mix index, average daily patient load and inpatient work units for hospital based laboratories, and ambulatory work units and outpatient visits for clinic based laboratories.

b. The indicators are based on workload, manpower, and expense. Ideally, data from a full fiscal year is used for analysis. The indicators are derived from CHCS workload and MEPRS reports. The TARA team members do not validate the data but accept it as reflected in the reports. Attention to detail by the laboratory manager and staff inputting the data is vitally important if accuracy of data is to be assured. Laboratory management personnel should validate Uniform Chart of Accounts Personnel System (UCAPERS) and CHCS workload input on a periodic basis.

c. The following data is collected and tabulated during a requested or medical center site visit:

(1) Workload

(a) D codes: ancillary Current Procedural Terminology (CPT) weighted procedures for 6 months and ancillary CPT reportable tests for 6 months.

(b) F codes: CPT weighted special programs procedures for 6 months and CPT reportable special programs tests for 6 months.

(c) Total workload: total CPT weighted procedures for 6 months and total CPT reportable tests for 6 months.

(2) Personnel

FTEs assigned
FTEs available
FTEs available and percentage assigned
Percentage of direct expenses (personnel)
CPT weighted/FTE (assigned)
CPT weighted/FTE (available)

CPT weighted/technical FTE (assigned)
CPT weighted/technical FTE (available)
CPT reportable tests/FTE (assigned)
CPT reportable tests/FTE (available)
CPT reportable tests/FTE (assigned)
CPT reportable tests/FTE (available)

(3) Expenses

D codes for direct, personnel, finance, support, and ancillary services
F codes for direct, personnel, finance, support, and ancillary services
Totals for direct, personnel, finance, support, and ancillary services

D Codes for ancillary cost/weighted test and ancillary cost/reportable test
Special programs (F Codes) for cost/weighted test and cost/reportable test
Total workload for total cost/weighted test and total cost/reportable test.

(4) Inpatient services

CPT weighted workload
CPT reportable tests
CPT weight per reportable
Laboratory expense
Cost per weighted procedure
Cost per reportable test
Laboratory cost per disposition

Laboratory cost per inpatient work unit
Dispositions
Case mix
Inpatient work units
CPT weighted disposition
CPT reportable disposition
CPT weight per inpatient work unit
CPT report inpatient work unit

(5) Outpatient services

CPT weighted workload

CPT reportable tests
CPT weight per reportable test
Laboratory expense
Cost per weighted procedure
Cost per reportable test
Laboratory cost per visit
Laboratory cost per ambulatory work unit

Outpatient visits
Average ambulatory units
Ambulatory work units
CPT weight per visit
CPT report per visit
CPT weight ambulatory work units
CPT report ambulatory work units
Average cost per visit

(6) Recapitulation

(a) Inpatient services: expense workload, percentage expense, and percentage workload;

(b) Outpatient services: expense workload, percentage expense, and percentage workload;

(c) Special programs: expense workload, percentage expense, and percentage workload; and

(d) Totals: expense workload, percentage expense, and percentage workload.

7-6. TELEPATHOLOGY

a. With the recent developments in telecommunications and telemedicine, telepathology is a new area of focus for the USAMMA. Currently telepathology is used at six Army MTFs for consultation services with the Armed Forces Institute of Pathology (AFIP) (Table 7-1). The technology used at these sites involve the lower end of telepathology where there is a camera attached to the microscope at the requesting facility. The pathologist selects images from the slide and sends them, as an e-mail attachment, across the Internet to the pathologist at the AFIP for review.

Table 7-1. Army Medical Treatment Facilities Using Telepathology

Bassett Army Community Hospital, Fort Wainwright AK
Bayne-Jones Army Community Hospital, Fort Polk, LA
Brooke Army Medical Center, Fort Sam Houston, TX
Darnall Army Community Hospital, Fort Hood, TX
Landstuhl Regional Medical Center, Germany
Tripler Army Medical Center, Honolulu, HI

b. While the application is useful at remote sites, there are many drawbacks to this technology. Still images from cameras do not provide for a complete review by the consulting pathologist. The consulting pathologist has to rely on the requesting pathologist to select the appropriate section as well as the appropriate microscopic view. In most cases that is

acceptable, but in rare cases where the requesting pathologist may not be aware of what to look for, there are concerns that the images are not representative of the problem cells. Thus, full implementation of telepathology at all of the Army MTFs has not been initiated. Consultation is achieved in other facilities by sending the slides, and in some cases the entire sections, overnight to the consultation site and the reports are sent by fax machine back to the facility.

c. Other telepathology technology involves use of whiteboards and video teleconferencing. This involves having the remote pathologist and the consulting pathologist meet through a video-teleconferencing session. The remote pathologist will maneuver the slide while the consulting pathologist reviews the images on the whiteboard screen. Although this increases the interaction between pathologists, having both pathologists available may be difficult for MTFs where there is a large difference in time zones.

d. Another technique is the use of a microscope with an automated stage and a video camera. There also can be a video camera at the grossing station to permit the consulting pathologist to identify what sections need to be taken. The slides that are made are then placed on the automated stage and the pathologist can remotely control the slide. This technology is the latest development, and although it is an improvement, there are still problems. The time that it takes for the stage instructions to be sent to the remote site and the image to be updated at the consulting site is significant. The network and telecommunication requirements to do this are also significant and can become expensive. Along with the telecommunication expenses, equipment expense is high, and justification for the expense is difficult when the slide can be sent by overnight mail to the pathologist.

e. Ideally telepathology will allow for the entire slide to be sent electronically to the consulting pathologist to review. Research is being done to develop this technology. One of the latest projects is virtual slide technology, although this is still in the development and validation stages. This technology proposes to digitize the entire slide view at a number of different depths at low power. These views will then be saved and sent electronically to the consulting pathologist. Once received, the pathologist can pull up the images, select the appropriate magnification and review the slide on the computer as he or she would on a microscope. The USAMMA is monitoring this technology and other developments and will work closely with the OTSG pathology consultant to assess the appropriate technological fit for telepathology within the Army MTFs.

CHAPTER 8. DIGITAL IMAGING AND THE DIGITAL IMAGING COMMUNICATION IN MEDICINE (DICOM) STANDARD

8-1. INTRODUCTION - DIGITAL IMAGING AND THE DIGITAL IMAGING COMMUNICATION IN MEDICINE (DICOM) STANDARD

a. Digital imaging has streamlined processes within the radiology department. Most of the tasks related to film production, transcription, and filing have been eliminated and replaced with the acquisition and storage of data on-line. An example of how digital technology has reengineered the radiology department is shown in Figure 8-1. To support digital imaging and the reengineering of the radiology department, all new purchases and upgrades should support the DICOM 3.0 standard. All diagnostic-imaging modalities will ultimately conform to DICOM standards. Focused purchases now of DICOM-conformant systems will later facilitate integration of acquisition devices to a hospital or radiology information system (HIS/RIS), an image management system, or PACS.

b. Two sets of specifications follow: a subset of the DICOM standard that is required to provide basic functionality and a set of specifications that is not required but highly recommended to accommodate workflow and data integrity.

8-2. RECOMMENDED SERVICE OBJECT PAIRS FROM THE DICOM STANDARD

a. It is desirable that, in addition to the requirements listed in Table 8-1, the modality provides standard conformance to the DICOM 3.0 SOP classes listed in Table 8-2. Each modality should conform to its appropriate DICOM Storage SOP class as an SCP.

b. Conformance to Modality Worklist Information Model Find as an SCU allows patient demographic and scheduling data from the RIS/HIS to be retrieved from an acquisition modality console and also allows the technologist to select the patient information from a "pick list" or using an Accession Number or Patient ID, rather than retyping the patient information. This capability enhances the efficiency and overall productivity of the technologist and reduces errors in patient demographic data that might result in exams that cannot be matched with the original order or other study components. The result should improve workflow and efficiency because data errors typically have to be corrected by a PACS system administrator.

c. The Storage Commitment Push Model SOP class ensures safe storage of the image data by the PACS before the data is deleted from local storage at the acquisition device (modality). This ability is important when sending images to a remote location, because the sender can rely on the receiver to take responsibility for the data.

d. The Modality Performed Procedure Step SOP Class communicates the study and other images performed as part of a particular study component from a different modality, using an information system and image manager.

Table 8-1. Required Modality DICOM Service Object Pair Classes

SOP Class Name	SOP Class UID	Usage
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	SCU
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	SCU
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	SCU
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.20	SCU

(con't) **Table 8-1. Required Modality DICOM Service Object Pair Classes**

SOP Class Name	SOP Class UID	Usage
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	SCU
Ultrasound Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	SCU
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	SCU
X-Ray Angiography Image Storage	1.2.840.10008.5.1.4.1.1.12.1	SCU
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	SCU
Patient Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.1.1	SCU/SCP
Patient Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.1.2	SCU/SCP
Study Root Query/Retrieve Information model-FIND	1.2.840.10008.5.1.4.1.2.2.1	SCU/SCP
Study Root Query/Retrieve Information model-MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCU/SCP
Verification	1.2.840.10008.1.1	SCU/SCP
Basic Grayscale Print Management Meta	1.2.840.10008.5.1.1.9	SCU

b. It is also highly desirable that the acquisition devices provide removable media, conforming to the DICOM media exchange application profiles as specified for that modality (e.g., CT or MR, x-ray angiography, ultrasound, or general purpose) using CD-R or magneto-optical disk to allow file exchange between workstations/facilities and to support failover operations in the event the network or PACS is down.

8-3. REQUIRED SERVICE OBJECT PAIRS FROM THE DICOM STANDARD

a. DICOM standards vary by modality and application. To exchange images, each modality should support the DICOM 3.0 image storage service-object pair (SOP) class for its modality as shown in Table 8-1 (e.g., a CT should comply with the CT image Storage SOP Class, ultrasound with the ultrasound SOP Class, etc.). To send or receive DICOM objects, such as images, support to a DICOM SOP class can be as a service class user (SCU), a service class provider (SCP), or both. At a minimum, support of a SOP Class as a User (SCU) is required.

b. Besides conforming to the individual modality SOP Classes, all acquisition devices should support the DICOM 3.0 query/retrieve, verification, and basic grayscale print management SOP classes (Table 8-1). Basic grayscale print SCU conformance facilitates networking of laser imagers and should eliminate the added expense of procuring modality interfaces for each acquisition device networked to the imager. DICOM query/retrieve SCU/SCP allows the modality to interactively give/pass patient demographic data and objects such as images to other acquisition devices, soft-copy display workstations, teleradiology spokes/hubs, and other PACS. DICOM verification SCU/SCP allows one DICOM-conformant system to ping another DICOM-conformant system and verify that the systems can talk to each other.

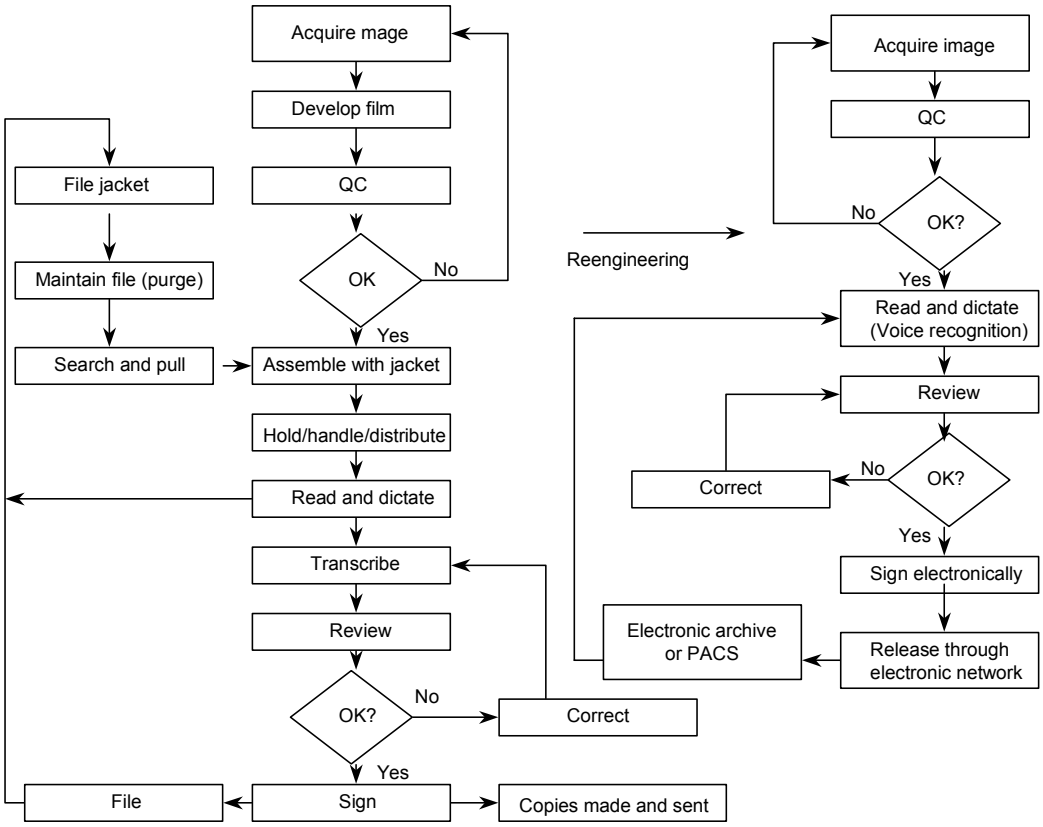

Figure 8-1. Reengineering the radiology department to incorporate digital imaging

8-4. THE OBJECTIVE IS IMPROVED ACCESS TO RADIOLOGY

The ultimate objective is to support business process changes throughout the MHSS, especially within the practice of military radiology. The vision for radiology is to create a seamless radiology department by eliminating the constraints that may be created by having multiple places where diagnostic imaging is conducted within and between Army and other DOD MTFs.

Table 8-2. Desired Modality DICOM SOP Classes

SOP Class Name	SOP Class UID	Usage
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	SCP
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	SCP
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	SCP
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.20	SCP
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	SCP
Ultrasound Multiframe Image Storage	1.2.840.10008.5.1.4.1.1.3.1	SCP
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	SCP
X-Ray Angiography Image Storage	1.2.840.10008.5.1.4.1.1.12.1	SCP
X-Ray Angiography Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	SCP
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	SCP
Modality Worklist Information Model-FIND	1.2.840.10008.5.1.4.31	SCU
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	SCU
Storage Commitment Push Model	1.2.840.10008.1.20.1	SCU

CHAPTER 9. SAMPLE DATA COLLECTION PROGRAM

9-1. INTRODUCTION - SAMPLE DATA COLLECTION PROGRAM

a. The USAMMA has decided to develop and implement a sample data collection program for targeted medical devices. This program is intended to be a comprehensive and cohesive data collection and analysis program. The Medical Engineering and Operations Directorate (MEOD) and MMT-S will be supplied with scheduled reports and have the ability to create ad hoc reports that will enable them to both respond to changes in medical technology in a timely manner and help identify significant trends in the maintenance of medical equipment. The overall focus of this program is to assist USAMMA in supplying medical field equipment to the Deployable Medical Systems (DEPMEDS) and other deployable facilities with current and sustainable medical technology in a fiscally efficient manner.

b. A part of the USAMMA's strategic mission is to support all the equipment required for deployable facilities. One of the largest users of medical devices is the combat support hospital (CSH). To maintain the sustainability and readiness of the CSH, USAMMA monitors technology and maintenance trends for medical equipment. Additionally forward surgical teams (FST) and both air and ground medical evacuation (MEDEVAC) transports units medical devices will be incorporated into this sample data. Obtaining sample data from these groups will give an accurate analysis of medical equipment from the battlefield (level I treatment) through the CSH (level III treatment) environment.

9-2. IDENTIFICATION OF KEY ELEMENTS TO BE MONITORED

a. To monitor the efficacy of the sample data collection program, there needs to be several indicators identified to track the affects of the program. Four parameters will be tracked and analyzed.

(1) Cost, including purchase price, repair costs and consumable consumption;

(2) Major weight, cubic volume, power requirements, water usage, and environmental deviations from equipment recommendations;

(3) Technological capabilities; and

(4) Required consumables.

b. These elements will be reviewed on a quarterly basis and the results will be entered into the monthly sample data collection report during the months of January, April, July, and October.

9-3. SAMPLE DATA COLLECTION ASSISTANCE VISIT POLICY

a. The sample data collection team will be conducting sample data collection assistance visits of the following facilities.

(1) A Regional Training Sites-Medical (RTS-MED) selected from one of the following sites:

(a) Fort McCoy
(b) Fort Gordon
(c) Parks Reserve Forces Training Area

(2) CONUS CSH units not visited by LAV and CSEA teams

(3) OCONUS CHS units not visited by LAV and CSEA teams

b. These visits will request the following information one month before the team deploys

(1) Written permission for the sample data collection team by the commanding officer.

(2) The most recent electronic copy of the Eagle database for the unit to be audited.

(3) An electronic copy of the sites maintenance records from the previous calendar year (TAMMIS).

(4) A point of contact for the audit team, along with the assignment of the technical representative from the base to be visited.

c. The sample data collection assistance visit team will consist minimally of the following members:

(1) Member of MMT-S

(2) One or more technical representative from base being audited (personnel should be assigned by Chief of Medical Maintenance from site being sampled).

d. The team for the sample data collection assistance visit will view the entire inventory of major medical devices and note any deviations from the Eagle database and the unit's property book. The sample data collection assistance visits will also capture any data available from the Forward Surgical Teams (FST), and area support medical companies that are based out of the site being visited. The sample data collection assistance visits team will also complete a survey with the Chief of Medical Maintenance. The sample data collection assistance visits team will collect a variety of data elements enabling them to produce a comprehensive final report and also populate the database for future analysis.

e. The sample data collection assistance visit report will be completed within 30 days after the site visit. The sample data collection assistance visit report will consist of listing of the deviations found from the Eagle database, a review of the completed survey form, an Microsoft Excel spreadsheet listing the data collected, and a written review of the visit. The sample data collection assistance visit report will be disseminated to the entire sample data collection team, the Commanding Officer, and Chief of Medical Maintenance of the CSH visited.

9-4. SAMPLE DATA COLLECTION GUIDELINES AND SAMPLE SECTORS

a. To obtain a cross-sectional data sample and use the expertise and functionality of existing staff, data inputs from the sources shown in Figure 9-2 will be used to populate the sample data collection database.

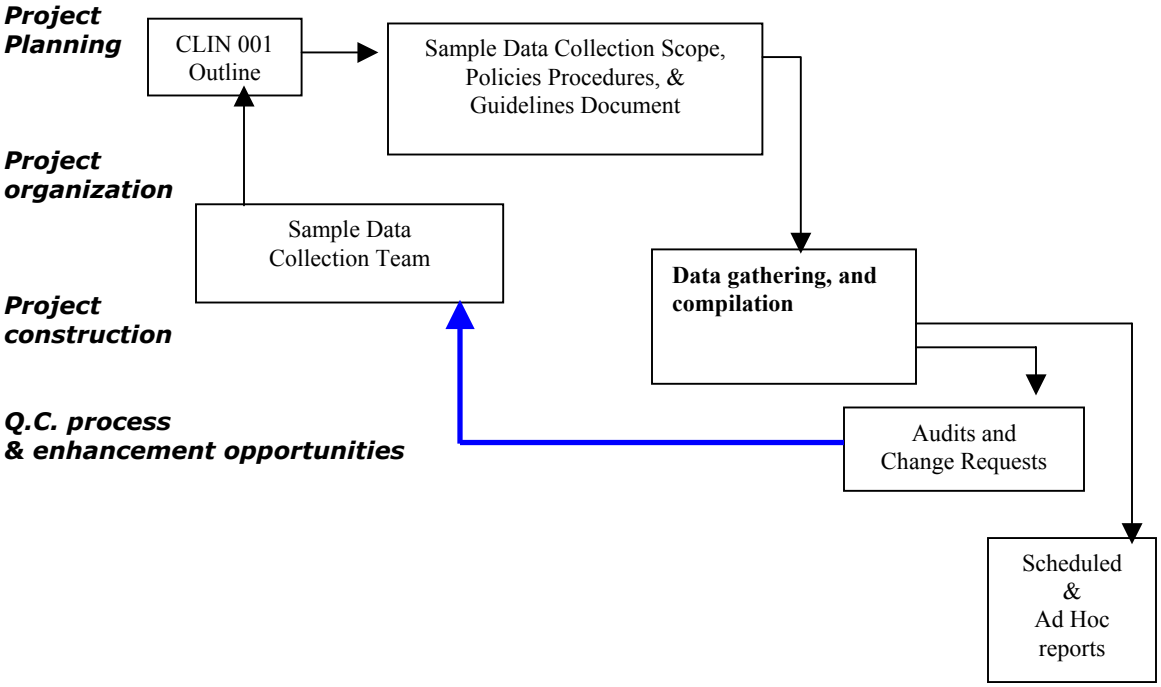

Figure 9-1. Sample data collection project

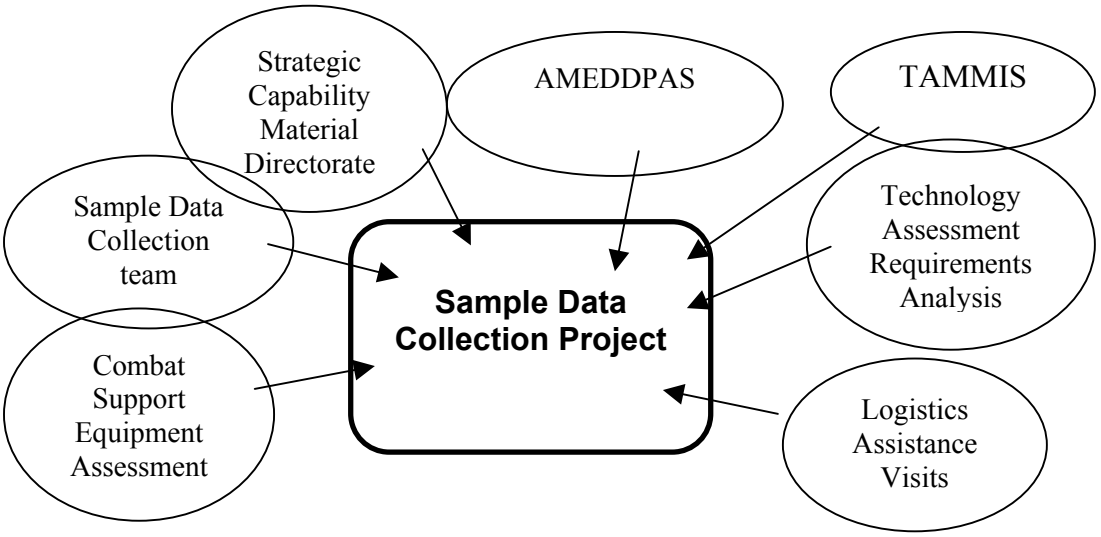

Figure 9-2. Sources of the data for the sample data collection project

b. Data from the CSEA, Strategic Capabilities and Materiel Directorate (SCMD) visits, TARA, and logistic assistance visits (LAV) is captured from the final written reports of these groups. Relevant data from these reports will then be manually entered into the sample data collection database.

c. Electronic data will be imported from the Army Medical Department Property Accounting System (AMEDDPAS) and Theatre Area Maintenance Management Information System (TAMMIS).

d. Scheduled reports will list data source to ensure each source is credited for work.

9-5. SAMPLE DATA COLLECTION PROGRAM MANAGEMENT POLICY

a. To ensure the success of the sample data collection project the following project management process will be used during the creation and management of this project (see Figure 9-1).

b. The sample data collection project will be controlled and monitored by the sample data collection team, which consists of a clinical engineer and biomedical technician and management representatives from the MMT-S and MEOD. The quality control (QC) process is intended to provide internal (through audits) and external (customer survey) feedback to fine-tune the data collection, reporting, compilation, procedures, and policies. This is designed to allow divergent thinking from the sample data collection team and allow the program the flexibility to quickly respond to changes in customer needs.

9-6. SAMPLE DATA COLLECTION QUALITY CONTROL PROCESS AND DATA VERIFICATION POLICY

a. To continuously monitor the sample data collection procedure, the following QC and data verification process will be used.

(1) Monthly scheduled meetings between the assistance visit team and representatives of the MMT-S and MEOD will be held. As the sample data collection program progresses, the monthly meetings will serve provide feedback to improve the program and increase customer satisfaction.

(2) Once the sample data collection assistance visits begin, there will be a survey completed by the Chief of Medical Maintenance. This survey will have questions intended to illicit responses from the field as to how the program can be improved. These survey results will be incorporated into the monthly sample data collection reports that will be disseminated to the members of MMT-S and MEOD and back to the site where the data was collected.

(3) Data verification from the sample data collection assistance visit will be accomplished using feedback provided by the submission to the completed report sent to the site. The data from the LAVs, CSEA, and Medical Reengineering Initiative data will already have been verified through the those programs internal QC programs. Data verification from TAMMIS will be verified by the Chief of Medical Maintenance during the sample data collection assistance visit.

CHAPTER 10. TELECOMMUNICATIONS

10-1. INTRODUCTION - TELECOMMUNICATIONS

a. The practice of both military and nonmilitary medicine relies heavily on the use of technology. Many new initiatives (e.g., those that relate to telemedicine or teleradiology) cannot be supported without upgrading the telecommunications infrastructure in Army MTFs.

b. The following sections discuss telecommunications equipment and protocols and their applications to Army MTFs.

10-2. 1,000 BASE-T TECHNICAL FUNDAMENTALS

a. Gigabit Ethernet cost-effectively leverages existing cabling infrastructures. It can be implemented in floor, building, and campus networks because it offers a wide range of connectivity media and connection distances. Gigabit Ethernet is designed to run over four media:

(1) Single-mode fiber, with connections up to at least 5 kilometers
(2) Multimode fiber, with connections up to at least 550 meters
(2) Balanced, shielded copper, with connections up to at least 25 meters
(4) Category 5 cabling, with connections up to at least 100 meters

b. The Institute of Electrical and Electronics Engineers (IEEE) 802.3z Gigabit Ethernet standard approved in June 1998 specified three transceivers to cover three media:

(1) 1,000 Base-LX for the installed base of single-mode fiber. 1,000 Base-LX transceivers can also be used to reach at least 550 meters on multimode fiber.
(2) 1,000 Base-SX for the installed base of multimode fiber.
(3) 1,000 Base-CX for a balanced, shielded copper cable that could be used for interconnects in equipment rooms.

c. IEEE 802.3ab, has defined the physical layer to run Gigabit Ethernet over the installed base of CAT-5 cabling. The IEEE Standards Committee approved the 1,000 Base-T standard in June 1999. Figure 10-1 summarizes the various Gigabit Ethernet options and the standards that define them.

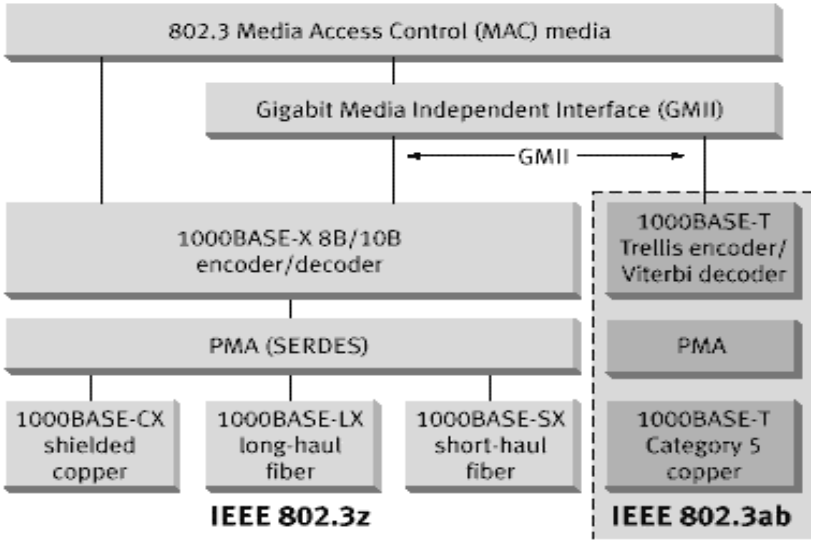

Figure 10-1. Gigabit Ethernet Media Options and Standards

d. 1000BASE-T is designed to run over Category 5 copper cabling. The transmission of 1 Gbps is possible thanks to the use of four twisted-pair links with 250 Mbps of throughput on each pair (250 Mbps x 4 = 1 Gbps).

e. 1000BASE-T transmits at the same clock rate as 100BASE-T (125 MHz) but uses a powerful signaling and coding/decoding scheme that enables the transmission of double the amount of data as 100BASE-T. Following is a comparison of the two specifications:

(1) 1,000 Base-T: 125 MHz × 2 bits = 250 Mbps

(2) 100 Base-TX: 125 MHz × 1 bit-symbol = 125 Mbit-symbol/s (Note: 125 Mbit-symbol/s is equivalent to 100 Mbps, since 100 Base-T uses a 4B/5B code—4 bits of data are translated into 5 bit-symbols before transmission on the wire; the effective bits throughput is thus 125 x 4 / 5 = 100 Mbps.)

f. 1,000 Base-T cost-effectively leverages the design of proven existing Fast Ethernet and V.90/56K modem technologies. Signaling and coding/decoding methods already implemented in 802.3 Fast Ethernet transceivers and in V.90 or 56K modems using advanced DSPs (Digital Signal Processing) are used to implement 1000BASE-T.

g. Migrating Ethernet/Fast Ethernet networks toward high-speed networking requires issues be addressed. 1,000 Base-T allows a simple performance boost to support exploding bandwidth requirements on today's networks. 1,000 Base-T is best suited for unclogging network bottlenecks that occur in three main areas:

(1) Workgroup aggregation.
(2) Connections to high-speed servers.
(3) Desktop connections.

The following scenario (Figure 10-2) describes a typical migration of an Ethernet/Fast Ethernet network to Gigabit Ethernet and shows the initial building backbone is 10/100 Mbps Ethernet/Fast Ethernet. Several Ethernet or Fast Ethernet segments are aggregated into a 10/100 Mbps switch, which in turn has several 10/100 Mbps Ethernet/Fast Ethernet server connections. Some users have dedicated 10/100-switched connections to their end stations. In this configuration, users are starting to experience slow response times and power users are experiencing bottlenecks.

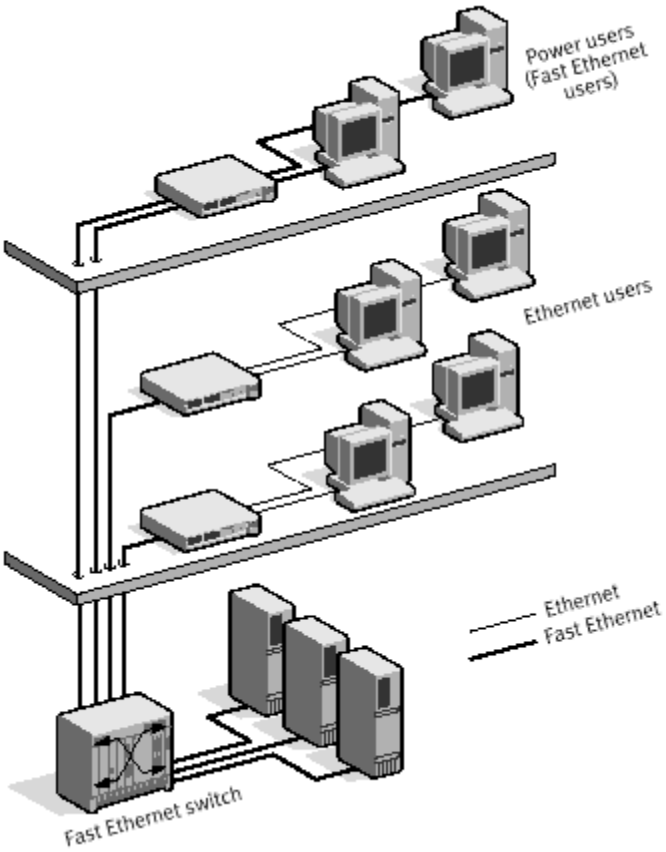

Figure 10-2. Ethernet/Fast Ethernet Network Before Migration to Gigabit Ethernet

h. The first upgrade phase is implemented in three areas (Figure 10-3).

(1) Upgrading the backbone with a 100/1,000 Mbps Fast Ethernet/Gigabit Ethernet switch

(2) Upgrading the workgroup switches that support power users or large workgroups with Gigabit Ethernet downlink modules

(3) Implementing 100/1,000 Mbps Fast Ethernet/Gigabit Ethernet network interface cards (NICs) in key servers

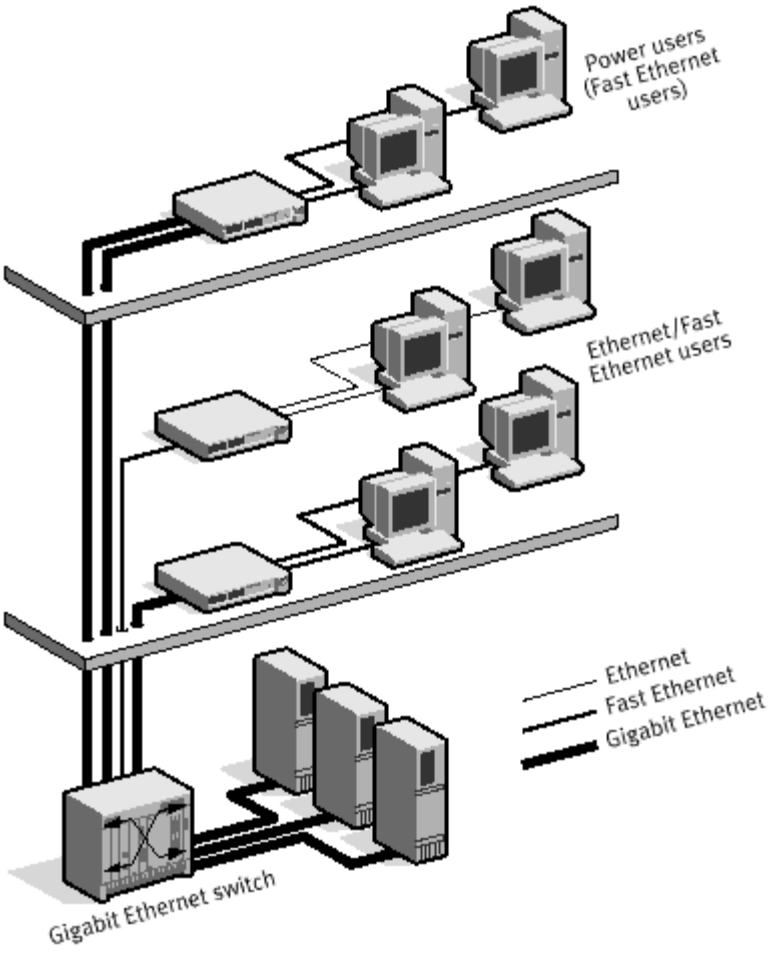

Figure 10-3. First Phase of Gigabit Ethernet Migration

i. As a result of these measures, the speed of the backbone increases tenfold to accommodate the overall increase in network bandwidth demand while the investment in existing workgroup switches, end-station NICs, and existing cabling is preserved.

j. The second migration phase is the upgrading of power users to 100/1000 Mbps Fast Ethernet/Gigabit Ethernet NICs (Figure 10-4). Fast Ethernet and, over time, Gigabit Ethernet to the desktop are now supported, giving power users full access to the resources of the network.

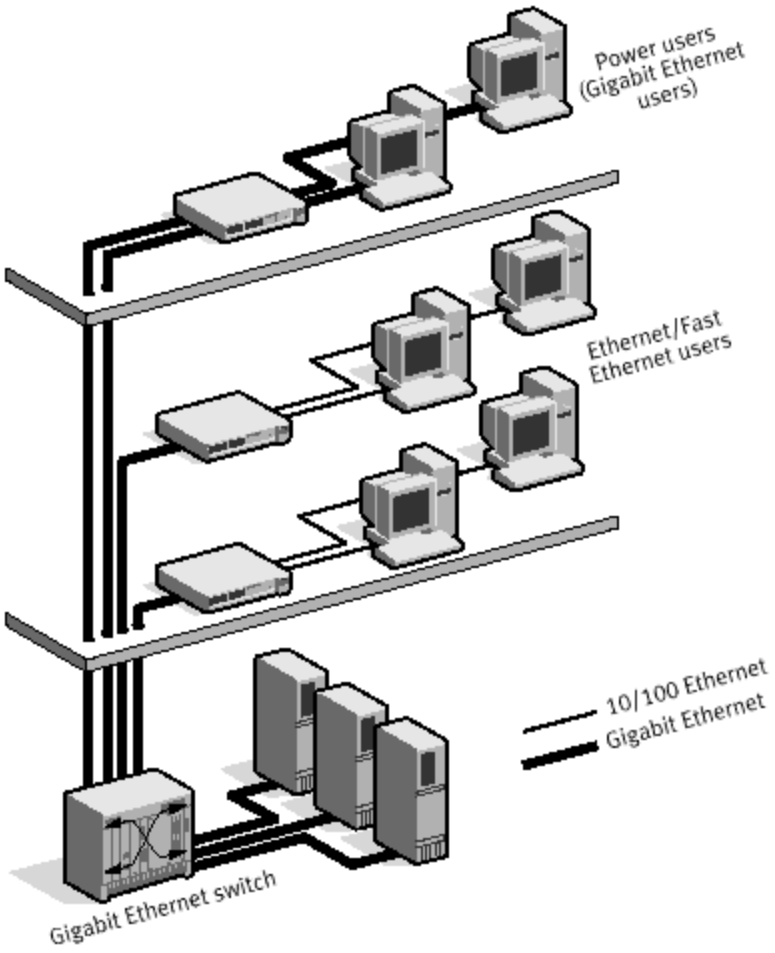

Figure 10-4. Second Phase of Gigabit Ethernet Migration

k. 1,000 Base-T, Gigabit Ethernet over CAT-5 copper cabling, helps network managers boost their network performance in a simple, cost-effective way while enabling migration of today's Ethernet/Fast Ethernet networks toward high-speed networking. The following is a summary of Gigabit Ethernet characteristics:

(1) 1,000 Base-T is Ethernet, providing speeds of 1,000 Mbps.

(2) 1,000 Base-T is designed to run over CAT-5 copper cabling, the most widely installed LAN cabling infrastructure.

(3) 1000 Base-T leverages the design of proven, cost-effective existing Fast Ethernet and modem technologies.

(4) 1000 Base-T can be progressively deployed in a Fast Ethernet network since 100/1,000 auto-negotiation will be supported in many 1,000BASE-T products.

10-3. LOCAL AND WIDE AREA NETWORKS

a. A LAN is a computer network that is confined to a limited area, such as a hospital network. A LAN could serve a room, a floor of a room, a building, or a group of adjacent buildings. Networks on a larger scale are referred to as a wide area network (WAN) or sometimes a metropolitan area network (MAN) if the network is confined to a metropolitan area. A WAN or MAN incorporates more than one LAN.

b. The typical use of a LAN is to tie together computers in an office in such a way that they can all use a single printer and a file server. LANs are also used to transmit e-mail between computers or to attach computers to a WAN or the Internet. Although the term LAN is used to refer to the file server, printers, and computers it supports, it also refers to the data communications wiring and other equipment (such as hubs or switches) that route data through the system.

c. Ethernet is probably the most common type of LAN in use. Ethernet is widely used because of its relatively low cost and variety of applications. It supports a variety of protocols and computer platforms at 1,000 Mbps. The different types of cable used in an Ethernet determine the network speed and cabling lengths. Other types of LAN design likely to be used in Army MTFs include the following:

(1) Fast Ethernet: Uses untwisted pair (UTP) or fiberoptic cable to transmit at either 10 or 100 megabytes per second (Mbps).

(2) Giga Ethernet: 1,000 Base-T, Gigabit Ethernet over Category 5 copper cabling leverages the organization's existing investment in Ethernet and Fast Ethernet infrastructures, and it provides a simple, cost-effective performance boost while continuing to use the dominant horizontal/floor cabling medium. 1,000 Base-T scales Ethernet 10/100 Mbps performance to 1000 Mbps. Flexible 100/1,000 and 10/100/1,000 connectivity will be offered and will enable the smooth migration of existing 10/100 networks to 1,000 Mbps–based networks.

(3) Token ring: Uses token passing in a physical ring. Each workstation in the network passes the token (data) on to the station next in the ring.

(4) Fiber distributed data interface (FDDI): Uses standard token ring passing network that uses fiber cabling and transmits at 100 Mbps up to 2 kilometers. FDDI provides network services at the same level as Ethernet and token ring.

(5) ATM: A cell-based transfer protocol that is discussed below in 10-3.g.

Each of these types of networks has limitations for either the number of computers supported or access speed, depending on network design and ability to process data. The choice of LAN should be tailored to each facility and depends on the number of users, bandwidth needs, and system requirements.

d. The largest network size is a WAN, such as MEDNET (Medical Network). A WAN can connect any number of LANs or other WANs. WANs normally use connections that can send data all over the world. For this reason, they are usually slower and more prone to errors than LANs or MANs.

10-4. NETWORK INFRASTRUCTURE

a. Until recently, modem technology limited the transfer of large data files to the upper limit permitted by an analog telephone line. COTS modems have a maximum speed of 56 kilobits per second (kbps) (not including cable modems) and are limited to the bandwidth available through the analog network, often resulting in a connection less than the advertised 56 kbps. This limited bandwidth creates long transfer times for large data files such as the files sent via teleradiology networks.

b. Digital technology now allows greater file capacity and faster transmission times. Facilities investing in network infrastructure should assess both the physical requirements

(e.g., cable) and electronic requirements (e.g., types of electronic transfer) before making infrastructure improvements or installing new networks. A significant issue to consider in making choices regarding network infrastructure includes the number and size of data files sent by the facility. In general, a facility that sends 8 to 10 images of 10 to 40 megabytes (MB) each day requires far less bandwidth than a facility that sends 8 to 10 similar images per hour.

c. Copper cable comes in two forms.

(1) UTP consists of insulated copper wires twisted within a protective jacket. This is typical of the cable located in most Army MTFs before it is upgraded by the Triservice Information Management Project Office (TIMPO). Copper cable comes in five grades designated categories 1 (CAT-1) through category 5 (CAT-5); the higher number signifies increasing data bandwidth support and cost. Use the following as a general guide for LAN cabling:

(a) CAT-1 and CAT-2 cable are no longer useful for LANs

(b) CAT-3 is typically used for Ethernet and 4-Mbps token ring LANs and will support up to 16 Mbps but is most often used in 10-Mbps applications.

(c) CAT-4 is normally used for 16-Mbps token ring LANs and used in general for longer distances and higher speeds than CAT-3 cable and can support up to 20 Mbps.

(d) CAT-5 supports 100-Mbps Ethernet; T1, fractional T1, and T3 lines; and ATM to the desktop at an operating rate of 155 Mbps.

(e) Giga Ethernet: 1,000 Base-T, Gigabit Ethernet over CAT-5 copper cabling leverages the organization’s existing investment in Ethernet and Fast Ethernet infrastructures, and it provides a simple, cost-effective performance boost while continuing to use the dominant horizontal/floor cabling medium. 1,000 Base-T scales Ethernet 10/100 Mbps performance to 1,000 Mbps. Flexible 100/1,000 and 10/100/1,000 connectivity will be offered and will enable the smooth migration of existing 10/100 networks to 1,000 Mbps–based networks.

(2) Coaxial cable, often used for transmission of cable television signals, consists of a single copper core, an insulator, and an outer jacket.

d. Fiberoptic cable is the best choice for high-bandwidth transmission offering transport capabilities ranging from the T1 rate of 1.544 Mbps to the synchronized optical network (SONET) range of 622 Mbps. Fiberoptic cable uses hair-thin filaments of transparent glass or plastic that carry light instead of electricity to transmit data, voice, video, and images. It is not subject to electrical interference. Although previously expensive, the cost of fiberoptic cable has fallen, and it is now competitive with high-grade copper cable for new installations. There are two types of fiberoptic cable.

(1) Single-mode cable is engineered for use over long distances and high bandwidth (e.g., 9.5 miles at 622 Mbps) and is more costly.

(2) Multimode cable is engineered for LANs (e.g., 700 feet at 155 Mbps or 300 feet at 655 Mbps). Fiberoptic cable is best for transfer of ATM protocols and, in general, is the best choice for new or upgraded teleradiology installations.

10-5. REMOTE ACCESS AND DATA TRANSMISSION

a. A T1 line is a conditioned telephone line (regenerators are placed in close succession to reduce line attenuation) that starts with two twisted wire pairs at the customer premises. Both voice and data can be multiplexed into the 24 channels that make up the T1 line. To connect to the user, a customer service unit (which diagnoses and prepares the signals on the line for the LAN), a data service unit (which converts LAN signals to T1 signals), and a multiplexer (which consolidates the multiple channels into the digital line) are used.

b. A standard T1 line provides 24 data or voice channels at 64 kbps plus 8 kbps of framing of bandwidth that is multiplexed so that 1.54 Mbps is available for transmission. A T1 carrier provides a dedicated point-to-point connection or can be integrated into a WAN, such as an ATM network. A T1 circuit provides a constant 1.54 Mbps of available bandwidth. A multiplexer allows different users to parse the T1 line into separate channels for their individual use. The monthly cost for a T1 line is often calculated based on distance, or the customer may pay monthly charges for the lease of a trunk line and user fees.

c. If the capacity of a T1 circuit is not needed, a facility has the option to procure a fractional T1 line. A fractional T1 line provides a dial-up operational bandwidth of 64 kbps to 768 kbps in increments of 64 kbps. A fractional T1 line will have the same appearance as a full T1, which is two twisted wire pairs.

d. A T3 line carries 28 T1 trunk lines with a total bandwidth of 45 Mbps. The cost of a T3 line is usually comparable to the price of 10 T1 lines. T3 lines are not routinely used as a part of a teleradiology network because the capacity far exceeds requirements. T3 technology increases the rate of data transfer for various modalities. A comparison of transmission times for using ISDN, T1, and T3 technologies is shown in Table 10-1.

e. ISDN is a digital communications technology that allows data to be transmitted across town or around the world using end-to-end digital connectivity. Connections established using ISDN are not subject to bit errors caused by the noise interference that is inherent in analog modems. The lower error rates of ISDN result in fewer retransmissions and greater network reliability.

(1) ISDN allows multiple digital channels to be sent simultaneously through the same regular telephone wiring. Although the same physical wiring can be used, a digital signal, rather than an analog signal, is transmitted across the line. Because the data rates of ISDN are higher than analog lines, transmissions times are shorter. In addition, the call setup time for ISDN is much shorter than for an analog transmission. This savings in time by ISDN results in greater productivity. The higher data rates of ISDN result in shorter connection times and lower access charges.

(2) ISDN data is carried by bearer channels (B channels) that occupy a bandwidth of 64 kbps. Some switches limit B channels to a capacity of 56 kbps. A data channel (D channel) handles signaling at 16 kbps or 64 kbps, depending on the service type.

(3) The ISDN user is charged a minimal monthly fee from the telecommunication service provider and then charged only for connection time. Users can minimize charges by taking advantage of off-prime time rates and dial-on-demand features. Users pay only for the amount of time they actually use the network. Users who require limited connection time can benefit from ISDN connectivity while minimizing their communications costs. There are two types of ISDN service.

Table 10-1. Time to Transfer Compressed Files Using ISDN, T1, or T3 Technology

Exam	ISDN 128 kbps (seconds)	T1 1.54Mbps (seconds)	T3 45Mbps (seconds)	Storage Requirement (MB)
3:1 Compression				
6.5-MB MRI Exam	135	11.3	0.39	2.16
9-MB Ultrasound Exam	188	15.6	0.53	3.0
15-MB Computed Tomography Exam	313	26.0	0.89	5.0
20-MB Digital Angiography Exam	417	34.6	1.19	6.7
32-MB CR Exam	667	55.4	1.90	10.7
30:1 Compression				
6.5-MB MRI Exam	14	1.13	0.04*	0.2
9-MB Ultrasound Exam	19	1.56	0.05*	0.3
15-MB Computed Tomography Exam	31	2.60	0.09*	0.5
20-MB Digital Angiography Exam	42	3.46	0.12*	0.7
32-MB CR Exam	67	5.54	0.19*	1.0

Storage is measured in bytes and transmission is measured in bits. There are 8 bits to a byte. In this table, a byte-to-bit conversion was used. To determine duration of transmission: the image (6.5 Mbps) was translated to bits (megabytes x 8), this sum (52,000,000 bits) is divided by the compression rate of 3 and 30 (17,333,333 and 1,733,333) and then divided by the transmission rate of ISDN at 128 kbps (135/13.5 seconds), T1 at 1.54 Mbps (11.3/1.13 seconds), and T3 at 45 Mbps (0.39/0.19 seconds). Storage is determined by dividing the image size in bytes by the compression rate (e.g., a 6.5-MB image compressed at a ratio of 3:1 is 2.16 MB. Likewise, compressing the same image at a ratio of 30:1 is 0.22 MB).

**Numbers are rounded to nearest hundredth.*

(a) Basic rate interface (BRI) consists of two 64-kbps B channels and one 16-kbps D channel for a total of 144 kbps. Channel aggregation protocols such as BONDING or Multilink-PPP support an uncompressed data transfer speed of 128 kbps. The data is carried by the two B channels; the D channel is used almost exclusively to carry routing information.

(b) Primary rate interface (PRI) is intended for users with requirements for greater capacity. Typically the channel structure for PRI is 23 B channels plus one 64-kbps D channel for a total of 1,536 megabits per second (Mbps). The PRI in the United States consists of 23 64-kbps B channels and one 64-kbps D channel (a 23B+D connection). With a total bandwidth of 1.544 Mbps, it is designed for transmission through a standard North American T1 trunk line.

f. Transmission standards differ in Europe and around the Pacific rim; in these areas the PRI is supplied through a standard 2.048-Mbps E-1 channel and consists of either 30 or 31 64-kbps B channels and one 64-kbps D channel (30B+D or 31B+D). However, although the specifics of ISDN implementation are slightly different from nation to nation, interconnections between any two systems in the world are possible and increasingly practical.

g. ATM is a cell-based data transfer protocol that supports many types of communication traffic, including voice, data, real time video, and imaging. The term asynchronous is used because the cells do not need to be transmitted on a synchronous periodic basis. ATM traffic is carried in a 53-byte fixed packet referred to as a cell. The fixed length allows all network switching to be performed in the hardware allowing the switching to be done quickly and economically. The ATM 53-byte cell is comprised of a 5-byte header and 48-byte payload. The cell payload is where data is carried. The header contains overhead information.

(1) ATM is a scaleable technology. ATM may be used at speeds ranging from slow (1.544 Mbps or less) to fast (10 gigabits per second [Gbps] and greater). It also means that the geographic scope of ATM can vary; the same technology that can be used in a LAN (at the desktop) may also be used in the infrastructure of a WAN. Because ATM uses cell switching, a smooth migration between applications and increased performance occurs, and protocol conversion and translation can be eliminated.

(2) ATM is a form of cell relay, where all transmitted data is fragmented into small, fixed-size data units called cells. Cell relay technology simplifies the statistical multiplexing of many different types of services, such as voice, video, image, graphics, and data. An advantage of ATM is that the cells can be transported over almost any medium such as multi-mode fiber, single-mode fiber or UTP copper cable. The best choice for transmission is fiberoptic cable.

(3) The fixed-size cell format also enables ATM cell switching to be implemented in hardware, as opposed to software. This results in transmission speeds in the gigabits-per-second range. Because cell transmission is asynchronous, ATM cells can send delay-tolerant data intermixed with time-sensitive data such as voice and video over the same facility network backbone. Through various traffic management techniques used on the network, time-sensitive traffic is given priority over delay-tolerant traffic.

(4) ATM is a connection-oriented technology, meaning that a connection must be established between two end stations before data can be transferred between them. An ATM connection specifies the transmission path, allowing the cells to self-route through an ATM network. Because ATM is a connection-oriented protocol, bandwidth is allocated only when a station requests a connection. By allocating bandwidth based on immediate user need, ATM can more easily handle the network's aggregate demand. This allocation can be accomplished without administrative intervention.

(5) The capability to support connection or connectionless applications enables ATM to support the higher layer protocols. This enables ATM to support connection-oriented protocols such as frame relay and connectionless protocols (i.e., Internet protocol and DICOM).

h. Other technologies exist in addition to ISDN and ATM to facilitate remote access. Digital subscriber line (DSL) technology includes asymmetric digital subscriber line (ADSL) and high-bit rate digital subscriber line (HDSL). DSL technology is oriented toward the provision of high-speed, high-quality transmission of data, voice, and video over existing copper wire, such as would be found coming into and used to connect to a workstation in a physician’s home. DSL technology allows high-speed transmission over copper wire. DSL technologies use modem-like devices that transfer data at rates of up to 6.1 Mbps.

i. ADSL allows a lower bandwidth to send data in the form of a request (1.5 Mbps to 6.1 Mbps) and a higher bandwidth to receive data (16 kbps to 640 kbps). This type of asymmetric bandwidth usage is typical of remote users clicking their computer mouse to retrieve large data files. The bandwidth required by the signal sent by the mouse click is small compared with the bandwidth required to receive the data. ADSL operates over the existing pair of copper wires found on in most facilities and offers the ability to carry a voice signal as well as data. ADSL is the most widely used DSL technology.

j. HDSL is a reliable, cost-effective means of providing repeaterless T1 service over two twisted-pair copper wires. HDSL transmits data as full duplex data transmission providing 2,048 Mbps for more than 5 miles without repeaters.

10-6. REMOTE ACCESS VIA THE INTERNET

a. Options exist for the home-based worker who wants to access the office LAN. Access can be granted through a remote access server. A remote access server allows access from a remote area, is transport independent, and can support multiple technologies.

b. The Internet encourages the use of remote access because it is an inexpensive way to connect to a LAN anywhere.

c. Remote access using the Internet is not without problems. Although security has been improved, it cannot be guaranteed. Performance availability of bandwidth can be unpredictable. Internet service providers and other network service providers that operate private Internet protocol networks are offering Internet-like services on their own networks. Virtual private networks, also known as "extranets," usually provide adequate bandwidth, security, and performance.

d. Cable modems can deliver a wide bandwidth, which may make Internet access easier. Some cable television companies are offering Internet access via existing coaxial cables for television and fiberoptic networks, and more are likely to do so in the future. Cable modem services are configured much like a shared Ethernet network, meaning all users share the same network. Although cable modems allow for rapid transmission of high volumes of data, the available bandwidth goes down slightly for each subscriber sharing a connection.

10-7. SWITCH TECHNOLOGY

a. Switches are intranetwork devices engineered to increase performance in the client-server environment by facilitating LAN segmentation. A LAN switch is a low-latency multicast bridge that creates separate LAN segments. Switches can be added without changing adapters, cabling, or hubs, preserving network investments. A switch interconnects elements of a distributed computing system, provides high-speed connections to enterprise backplanes and servers, and scales network bandwidth by adding more switching ports. In using switching technologies to create and manage virtual LANs, a logical grouping of users independent of their physical location becomes possible and facilitates dedicated bandwidth to specific users or groups of users.

b. Switching technology allocates dedicated bandwidth to each user. As LAN-switching technologies have become more popular, cost and performance factors have improved compared with competing technologies. Previously for most facilities, placing switches in the wiring closet instead of routers was perceived as cost prohibitive. Facilities felt they could only afford a small number of switches, and they used them to address immediate needs such as LAN segmentation. As the technology has matured, performance has increased while the price dropped.

c. A number of vendors offer high-speed LAN switching technology. The LAN Modernization Working Group of the Triservice Information Management Project Office (TIMPO) is testing this technology. This office is in the process of drafting one or more common architecture standards for LAN modernization. These standards, once complete, should provide a flexible, robust, integrated, scaleable information infrastructure to support all application requirements of the medical enterprise, and eliminate the need for multiple solutions.

10-8. TELERADIOLOGY

a. Teleradiology is a means of electronically transmitting radiographic patient images and consultative text from one location to another.

b. Costs for teleradiology equipment can vary from $15,000 to $20,000 for low-end equipment to more than $100,000 for high performance systems. Typically a high-quality sending station will cost about $35,000 to $40,000 and a dual CRT receiving/viewing station will be $45,000 to $55,000.

c. The three most important specifications for a teleradiology sending station are image resolution, compression, and transmission speed.

(1) Image resolution is the ability of an imaging system to differentiate among objects. When a sending station digitizes an x-ray film it breaks it into a two dimensional matrix of small elements called pixels. As the digitizer reads the image, the information contained in each pixel is assigned a number, which represents the amount of density (information) it contains. This number is the gray scale (or density) number. A pixel that has a lot of information (black) would be assigned a higher number than a pixel with little information (light). The more pixels in an image and the greater the range of density numbers per pixel, the better the image resolution. Typical resolution matrix sizes offered today by vendors are 512 × 512 (512 pixels wide by 512 pixels high), 1,024 × 1,024, and 2,048 × 2,048. Typical gray scale ranges offered are 256 (8 computer bits deep) to 4096 (12 computer bits deep) shades of gray. Although increasing the matrix and gray scale range improves the image resolution, it also requires more information that has to be sent via the transmission network. For example: an image that is digitized at 512 × 512 × 8 requires 2,097,152 bits of information to be transmitted, while an image that is digitized at 1,024 × 1,024 × 12 has 12,582,912 bits of information. The latter is six times larger than the former ands take six times longer to transmit.

(2) Compression is a software technique by which certain pixels in the digitized image are dropped to decrease transmission time. Compression is expressed as a ratio. A compression ratio of 10:1 means that for each pixel of information retained from the original digitized matrix, 10 have been dropped before transmission. There are numerous compression algorithms in use ranging from 2:1 to 15:1 or higher. Compression algorithms below about 3:1 are usually considered lossless; i.e., no information contained in the original digitized image is lost. Compression ratios above this are considered lossy (destructive) and can result in image degradation.

(3) A modem is the interface unit between the image digitizer and the transmission network. It converts digital image data to electrical impulses, which can be sent along the transmission media. The rate at which a modem can perform this conversion is given in bits per second (bps). The ideal teleradiology sending station would have very high resolution, little or no compression, and very high transmission speeds. This is not possible in the real world because optimizing one parameter negatively affects another (e.g., increasing resolution matrix size increases transmission time). How does one select a teleradiology-sending unit to balance resolution, compression, and transmission speed parameters? If economically feasible, one selects a sending station that has a reasonably fast modem, operator-selectable resolution of 512 to 2,048 bits, and several selectable compression levels. A station with this flexibility will allow the sender (and receiver) to decide on a case-by-case basis which is more important: quality of the received image or the speed at which it arrives. If selectable resolution and compression are not an option, the sending station should have a reasonably high fixed resolution (1024 × 1024 × 12) and lossless compression (3:1).

CHAPTER 11. VOICE-RECOGNITION SOFTWARE FOR DICTATION AND TRANSCRIPTION

11-1. INTRODUCTION - VOICE-RECOGNITION SOFTWARE FOR DICTATION AND TRANSCRIPTION

a. Voice-recognition software allows physicians to dictate their patient notes directly into a computer and then electronically transfer that transcription to a hospital information system (HIS) such as CHCS. Large-scale systems are configured in a distributed processing, client-server architecture. This requires a server, an operating system, controllers, workstations, applications programs with clinical and management features, and peripherals such as input/output and storage devices. The server provides applications processing and database management; the clients provide a user interface and application-specific functions. Small-scale systems are configured with the voice-recognition software running on laptop or desktop personal computers that are directly networked to a HIS.

b. Improvements in voice-recognition software allow physicians to speak naturally into their computers without the awkward pause between each word that characterized earlier computer dictation systems. The latest software allows physicians to dictate at rates of 60 to 100 words per minute directly into the computer. Voice-recognition software requires some training but usually no more than 30 minutes.

c. Some vendors claim accuracy for their software as high as 95 percent for native North American English speakers, although typical accuracy for voice-recognition software in general is probably 85 to 90 percent. Voice-recognition software increases the confidentiality of patient notes and charts through reduced reliance on outside services. A radiologist can use voice-recognition software to download radiology orders and patient demographics already entered into the RIS/HIS, and this information can be merged into the report. The final radiology report can be uploaded for storage directly on the RIS/HIS via LAN connections. This results in a dramatic reduction in turnaround time because the transcription is available for immediate use.

d. Initial trials at some sites indicate that radiologists can virtually eliminate the administrative portion of the radiology dictation cycle. Our TARA economic analysis shows that the initial cost of the system will be recovered in less than one year for most medical treatment facilities. Voice-recognition software can in theory provide almost instantaneous availability of reports. However, physicians still need to check and edit the reports for accuracy, even with voice recognition and automatic transcription. However, overall turnaround time for reports is dramatically reduced.

11-2. AMEDD CONTRACT FOR VOICE RECOGNITION SOFTWARE, DICTATION, AND TRANSCRIPTION PRODUCTS

a. In August 2000, the AMEDD awarded a contract worth up to $30 million to Dictaphone to provide dictation and transcription solutions, including a forthcoming Internet-based product. The contract includes Dictaphone Enterprise Express Voice, Text software and other continuous speech recognition products. This will provide the Army with automated solutions for the creation, management, and analysis of patient medical records for fixed medical facilities worldwide.

b. The contract was awarded by the AMEDD's Central Contracting Activity in San Antonio. The contract calls for an initial delivery of Enterprise Express Voice, Text and continuous speech recognition products and services to a number of sites. The Army Office of the Surgeon General provides strategic planning and implementation oversight. Dictaphone has established a central program office in Melbourne, Florida, which will manage installation and sustainment over the life of the systems.

c. Dictaphone plans for its products to convert large volumes of text into data by applying coding, data mining, and clinical language technologies to support applications such as coding and abstracting, utilization reviews, decision support, and outcome analysis. The data would be quickly and easily accessible enterprise-wide via a Web-based work flow management and communications system.

d. The sites currently under contract to have the Dictaphone products are:

(1) European Regional Medical Command
  (a) Landstuhl Regional Medical Center
  (b) U.S. Army Medical Community Hospital in Heidelberg
  (c) Wuerzberg Combat Support Hospital

(2) North Atlantic Regional Medical Command
  (a) Walter Reed Army Medical Center
  (b) Keller Army Community Hospital (West Point)
  (c) DeWitt Army Community Hospital (Fort Belvoir)

(3) Southeast Regional Medical Command
  (a) Eisenhower Army Medical Center
  (b) Blanchfield Army Community Hospital (Fort Campbell)
  (c) Winn Army Community Hospital (Fort Stewart)

(4) Great Plains Regional Medical Command
  (a) Brooke Army Medical Center
  (b) Leonard Wood Army Community Hospital (Fort Leonard Wood)
  (c) Evans Army Community Hospital (Fort Carson)
  (d) Bayne-Jones Army Community Hospital (Fort Polk)

(5) Madigan Army Medical Center in the Western Regional Medical Command

e. All sites above are operational with voice and text capability. Speech recognition and CHCS bi-directional interfacing is planned for integration with the voice and text systems for full functionality at all of these sites by 30 September 2002.

11-3. NOTES ON THE USE OF VOICE DICTATION IN THE RADIOLOGY DEPARTMENT AT DWIGHT DAVID EISENHOWER ARMY MEDICAL CENTER (DDEAMC)

a. The radiology department at DDEAMC currently uses a voice dictation system for all reports. The distributed server-client dictation system (ITS Speech) was installed in April 1998 at a cost of about $125,000 and is provided on 13 personal computers within the radiology department. To use the system, the user logs into CHCS. Once in CHCS, the correct patient exam is brought up with the transcription field exposed, after making sure the cursor is in the correct position to accept a report. Next, the user logs into the ITS text editor and begins his or her dictation. The completed report can either be forwarded by a mouse click or voice command.

b. There are two methods to send the report to CHCS:

(1) The report can be sent directly to CHCS or can go through a "finalize mode" where the text is reviewed and new words are added to the voice dictionary database.

(2) The finalize mode is preferred because it allows the software to enhance its own word library. The radiologist is still required to verify his or her report within CHCS.

c. DDEAMC plans on continued use of the ITS Speech product until the Dictaphone system is fully implemented and operational.

2002 GLOSSARY FOR SB 8-75-S5

ACN	Acquisition Control Number
ACR	American College of Radiology
ACSIE&FM	Acting Chief of Staff for Installations, Environment, and Facility Management
ACSLOG	Acting Chief of Staff for Logistics
AFIP	Armed Forces Institute of Pathology
ALSI	AMEDD Limited Support Item
AMC	Army Medical Center
AMEDD	Army Medical Department
AMEDDC&S	Army Medical Department Center and School
AMEDDPAS	Army Medical Department Property Accounting System
AML	area medical laboratory
APPMO	Army PACS Program Management Office
AR	Army Regulation
ATH	air transportable hospital
ATM	asynchronous transfer mode
BLIC	Budget Line Item Code
BPR	business process review, business process reengineering
BRI	basic rate interface
CAT-1, CAT-2	category 1, category 2, etc.
CCD	charge-coupled device
CEEP	Capital Equipment Expenditure Program
CHCS	Composite Health Care System
CONUS	Continental United States
COTS	commercial-off-the-shelf
CPT	current procedural terminology
CR	computed radiography
CSEA	Combat Support Equipment Assessment
CSH	Combat Support Hospital
CT	computed tomography
DA	Department of the Army
DCA	Deputy Commander for Administration
DCSIE&FM	Deputy Chief of Staff for Installations, Environment, and Facility Management
DCSLOG	Deputy Chief of Staff for Logistics
DEPMEDS	Deployable Medical Systems
DHP	Defense Health Program
DICOM	Digital Imaging and Communication in Medicine
DIN-PACS	Digital Imaging Network-Picture Archiving and Communication System
DIRS	Diagnostic Imaging and Radiotherapy Subcommittee
DMIS	Defense Medical Information System
DMIS-SS	Defense Medical Information System-Summary System
DOD	Department of Defense
DPW	Department of Public Works
DSCP	Defense Supply Center Philadelphia
DSL	digital subscriber line
FDA	Food and Drug Administration
FDDI	fiber distributed data interface
FEA	Military Radiology Functional Economic Analysis
FIB	facility information bulletin
FST	Forward Surgical Team
FTE	full-time equivalent
FY	fiscal year

Gbps	gigabits per second
GEMS	GE Medical Systems
GME	graduate medical education
GSA	General Services Agency
HSC	Health Service Command
HDSL	high-bit rate digital subscriber line
HDV	high-dollar value
HFPA	Health Facility Planning Agency (U.S. Army)
HIS	hospital information system
ISDN	integrated services digital network
ISO	independent service organization
JHMET	Joint Healthcare Management Engineering Team
JPEG	Joint Photographic Experts Group
Kbps	kilobits per second
LAN	local area network
LAP	Logistics Assistance Program
LAV	logistics assistance visit
LUC	local use code
MAN	Metropolitan Area Network
MASH	mobile army surgical hospital
MB	megabytes
Mbps	megabits per second
MC4	Medical Communications for Combat Casualty Care
MCMR	Materiel Command and Medical Research (used for correspondence)
MDIS	Medical Diagnostic Imaging Support
MEDCASE	Medical Care Support Equipment
MEDCEN	medical center
MEDDAC	medical department activity
MEDEVAC	medical evacuations
MEDNET	Medical Network
MEOD	Medical Engineering and Operations Directorate
MEPRS	Medical Expense and Performance Reporting System
MHS	Military Health System
MILCON	military construction
MIPR	Military Interdepartmental Purchase Request
MMM-P	USAMMA National Maintenance Point
MMT	USAMMA Materiel Acquisition Directorate
MMT-C	USAMMA Materiel Acquisition Directorate, Contract Integration Division
MMT-S	USAMMA Materiel Acquisition Directorate, Technology Support Division
MPR	MEDCASE program requirement
MRE	MEDCASE requirement and execution
MRMC	Medical Research and Materiel Command
MR	magnetic resonance
MRI	magnetic resonance imaging
MSC	Major Subordinate Commands
MTF	medical treatment facility
NEMA	National Electrical Manufacturers Association
NNI	Nonsupportable, Nonsustainable, and Obsolete Items (of equipment)

2002 GLOSSARY FOR SB 8-75-S5

O&M	operations and maintenance
OCONUS	outside the Continental United States
OEM	original equipment manufacturer
OMA	Operation and Maintenance, Army
OTSG	Office of The Surgeon General
PACS	Picture Archiving and Communication System
PBAC	Program and Budget and Advisory Committee
PMT	photomultiplier tube
POC	point of contact
POM	program objective memorandum
PPM	parts per million
PRI	primary rate interface
QC	quality control
R/F	radiographic/fluoroscopic
RIS	radiology information system
RMC	Regional Medical Command
RTS-MED	Regional Training Sites-Medical
RVU	relative value unit
SB	Supply Bulletin
SCMD	Strategic Capabilities and Materiel Directorate
SCP	service class provider
SCU	service class user
SOP	service-object pair
STCPC	Strategic Technology and Clinical Policies Council
SONET	Synchronized Optical Network
TAML	Theater Area Medical Laboratory
TAMMIS	Theater Area Maintenance Management Information System
TARA	Technology Assessment and Requirements Analysis
TDA	Tables of Distribution and Allowances
TIMPO	Tri-service Information Management Project Office
TOE	Tables of Organization and Equipment
TRICARE	Health Maintenance Organization for military personnel, dependents, and retirees
UCAPERS	Uniform Chart of Accounts Personnel System
UIC	unique identifier code
USAMEDCOM	U.S. Army Medical Command
USAMMA	U.S. Army Medical Materiel Agency
USAMRMC	U.S. Army Medical Research Materiel Command
UTP	untwisted pair
WAN	wide area network

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